Feb 1960

EDITORIAL

ACCORDING to a recent news item, scientists at Green Bank, in America, are planning to listen systematically during 1960 for signs of "intelligent" radio signals from other solar systems. Said the heading to the article, "We Should Soon Know."

Speculation about life elsewhere in the universe is not new, of course. The question has been argued without resolution ever since man realised the true nature of the stars. Many of us may yet live to know the answer.

Whatever our beliefs, it is not difficult to agree with Britain's Professor Morrison that "statistics" supported the possibility, if not the probability, of life elsewhere. Whether we regard life as something essentially spontaneous or dependent on a Creator, it is hardly logical to assume that it has been gendered only on one tiny planet in a whole, vast universe.

This might suggest, in turn, that it is almost inevitable that we contact other life forms, sometime, somehow, or be contacted by them.

Before proceeding to such a conclusion, however, it is necessary to allow for another "statistic" relating the supposed enormous geological age of the earth with the very few years during which our civilisation has been able to claim any degree of technical enlightenment.

The likelihood of our contact with other "civilisations," based on the number of planets, must be modified by the chance of such civilisation being coincident with ours or, at least, in a suitable space-time relationship.

But if intelligent creatures do exist on other planets, and if some of them are as technically advanced as we are, then it is logical to expect some contact by radio. For the first time we have huge steerable antennas and low-noise amplifiers, which may conceivably separate something systematic out of the random noise coming from outer space.

On the other hand, neighbouring civilisations could still be in their "stone age." In the calendar of the universe, the gap would be microscopic, but it could embrace enormous advances in technology on earth.

Perchance, before other life forms discover and utilise radio, earth vehicles will have landed in their backyard.

The same is true in reverse, of course. Perhaps it is significant that we have, thus far, heard no transmissions from outer space, nor have we consciously received visitors therefrom. Perhaps our civilisation is unique or, at least, well advanced of others in our celestial "neighbourhood."

W. H. Williams

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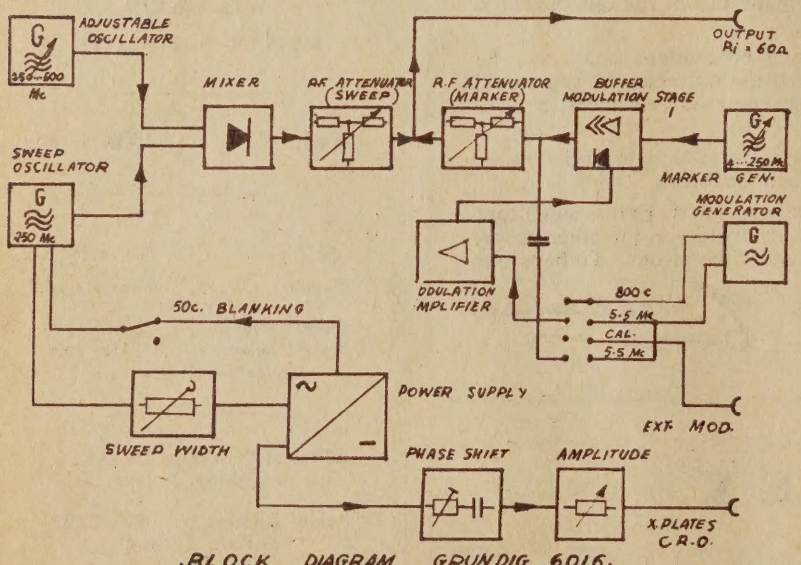

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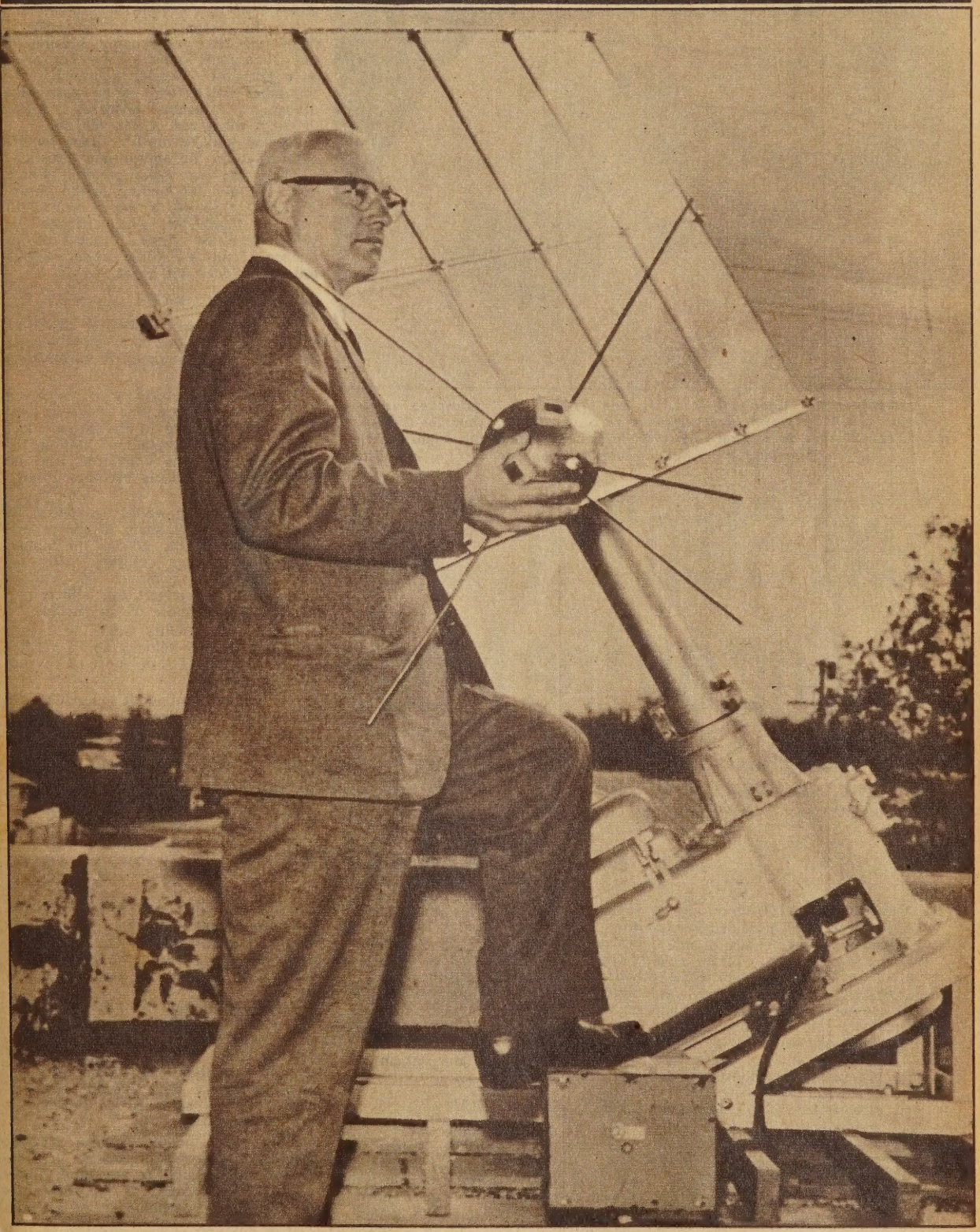

Converting sunlight directly into electrical energy, this 8ft x 4ft bank of silicon-solar cells tracks the sun automatically and operates a door-opening device at the new semi-conductor division of the Hoffman Electronics Corporation. Company President, H. L. Hoffman, holds a replica of the Vanguard 1 satellite, which used the first solar cells to operate in space.

A segment of the Moon's surface, as seen by the giant telescope at Mt Palomar, U.S.A. Without an atmosphere to support a parachute or balloon, scientists will have to rely on rocket techniques to reduce the impact when instruments are finally landed on the Moon.

Next Step? A 'Soft' Landing on the Moon

A "soft landing" is expected to be the next major development in Russia's space program and could come quite soon. Errors of operation which must be anticipated are discussed here. It is concluded that liquid propellants would offer advantages over solid.

By DENNIS S. CARTON*

THE Russian space research program, which is now being unfolded, seems to have the Moon as its centre of interest, and it is likely that one of the next major events will be an attempt to land instruments on the surface of the Moon.

I shall assume in the discussion that follows that the Russians are able to send a payload of about 800lb to the vicinity of the Moon with reasonably high accuracy—as was demonstrated by Lunik II.

I shall also assume that they have developed equipment able to convey commands to, and information from, a vehicle when it is near to the Moon; and that they are able to align the payload so that it points towards the centre of the Moon with reasonable accuracy.

Lunik III has shown that both these requirements have been achieved.

The problem is thus reduced to deciding what behaviour we require of the vehicle as it approaches the Moon and how "soft" the impact must be if the instruments are to survive it.

Obviously the more rugged the device and its instruments can be made, the more likely they are to survive impact on the Moon's surface.

Great strides have been made in developing "shock-proof" instruments, for instance, by encapsulating them in a synthetic resin.

LIKELY ASSUMPTION

We do not know how far the Russians have succeeded in developing crash-proof instruments, but, for the sake of argument, I shall assume that the actual impact velocity on the Moon must be kept down to a few feet per second — the equivalent of a fall of a few feet on Earth.

Provided that the impact speed can be kept low enough, a shock absorber of some kind can be built into the vehicle so that the deceleration of the instruments is kept at a safe value.

If the Moon has a dust surface this might be used to take the shock of the instrument package landing, and the problem would be less serious. On the other hand, the surface might be hard rock. We must assume the latter if the risk of failure is to be minimised.

As the Moon has no atmosphere, the problem of aerodynamic heating of the fast-moving vehicle does not arise as it does for an Earth approach. On the other hand, there is no possibility of using a parachute device as a brake to check the speed of the vehicle.

All the braking must be done by firing rockets in the appropriate direction.

There are two types of orbit which might be used for landing on the Moon. The first is to use a course similar to that of Lunik III, which carries the vehicle into the Moon's "sphere of influence" (that is, within about 40,000 miles) but does not hit it.

HYPERBOLIC PATH

Because the vehicle must be travelling relative to the Moon at a speed greater than the escape velocity, it moves in a hyperbolic path.

If, when the vehicle is at its closest to the Moon (Figure 1) a rocket is fired with thrust parallel to the surface and opposite to the direction of motion, the hyperbolic path is converted into an ellipse and the vehicle becomes a satellite of the Moon.

Further braking would be applied by starting the rocket again to convert the ellipse to one which "grazed" the Moon's surface — missing collision with the actual surface by a mile or so. Further braking would convert this ellipse into a circular orbit close to the surface.

Finally the satellite would be braked to below circular velocity and a vertical rocket fired to take up most of the impact (Figure 2).

The second method of approach is to use a trajectory like that of Lunik II, aimed at colliding with the Moon. But just before the collision the vehicle would be turned so that the thrust from a rocket acted as a brake and reduced the impact velocity to zero, or nearly so.

The first method has the disadvantage that the braking rocket must be started and stopped a number of times. On the other hand, the adjustment of the lunar satellite orbit could be made in a number of steps and the result of each could be observed before making the next correction.

The second method requires accurate delivery by the carrier rocket. In spite of this the second is the more likely to be used, because of the difficulties of starting and stopping rocket engines.

The question is how practicable it is to reduce the speed of the landing vehicle to exactly zero at the moment it reaches the Moon's surface.

Calculations show that, without any braking at all, it would hit the surface at a speed of from 7,700ft/sec to much

*College of Aeronautics, Cranfield.

more than 10,000ft/sec, depending on the launching speed from the Earth. The lowest impact velocity corresponds to the minimum launching velocity and the maximum journey time of about five and a half days (see figure 3).

If we choose this low-speed approach to the Moon a smaller braking rocket will be required than if the launching and impact velocities were higher. This could have the attraction that more of our 800lb total payload could be devoted to instruments.

But there is a disadvantage in using this "slow" journey, since any error in launching speed or direction would have a much larger effect on the accuracy of the shot when the speed is near the minimum. The answer is a compromise which would be decided only after detailed study of the accuracy of control that could be obtained.

Ideally the reverse thrust of the braking engine would slowly counteract the speed of the vehicle relative to the Moon until at the same instant the velocity was just reduced to zero, the last drop of propellant was burned and the vehicle just touched the surface.

HIGH ACCURACY

Such an ideal requires that the duration and level of thrust, and also the height at which the thrust is started, should all occur with complete accuracy. In practice such accuracy cannot be achieved.

In the discussion that follows I shall examine in some details the errors of operation which can occur in practice, which must be anticipated, and their effects on the approach and landing. In the first place, the examination will consider a simple propulsion system without thrust control.

Errors in the duration or level of thrust would result in the vehicle undergoing a change in velocity different from that required. Too great a change in velocity would bring the vehicle to rest relative to the surface of the Moon, but the rocket engine would continue to fire after this moment and the vehicle would start to climb again.

On the other hand, an insufficient change in velocity would mean that the engine would not produce zero velocity without the unwanted assistance of the surface of the Moon.

HEIGHT ERRORS

A different kind of effect would occur through errors in height at which thrust is initiated. For instance, ignition one-tenth of a second early could result in the vehicle being brought to rest at an altitude of 1,000 feet, followed by a fall to the surface.

The speed of impact would then be about 100ft/sec—nearly 70 m.p.h.

Careful attention to aspects of design can reduce the magnitude of the errors that occur.

Nevertheless, examination of the problem of operation of a simple propulsion system indicates that it will always be liable to deviations from standard greater than can be tolerated. An alternative must therefore be sought.

An attractive alternative would be to include a separate small landing rocket engine. Such an arrangement would be less complicated than a liquid propellant engine with a thrust control, would have a greater flexibility than a thrust cutoff mechanism, and would be equally useful with either a solid or a liquid propellant system.

Such a rocket would be used nearly at the end of the landing procedure. At the moment of ignition the velocity and height would be small. The accuracy of ignition would therefore be higher than with the main engine ignition. A measure of flexibility could be built into such an arrangement.

The best moment for ignition of the small engine could be based on a com-

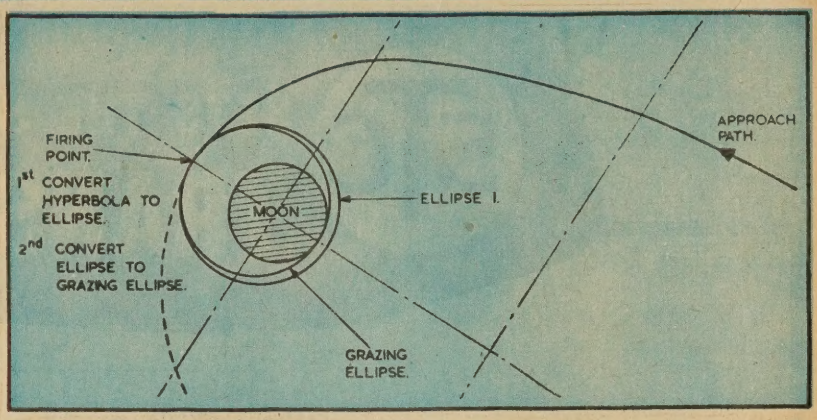

Figure 1: Moon landing. Hyperbolic ellipitical approach.

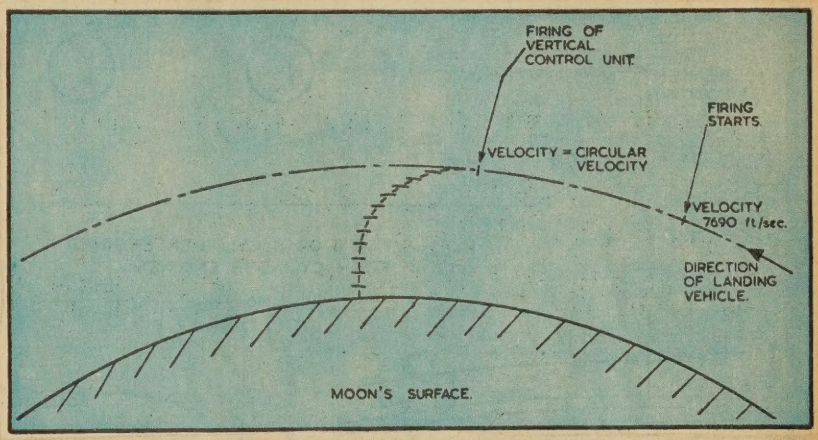

Figure 2: Grazing ellipse landing technique.

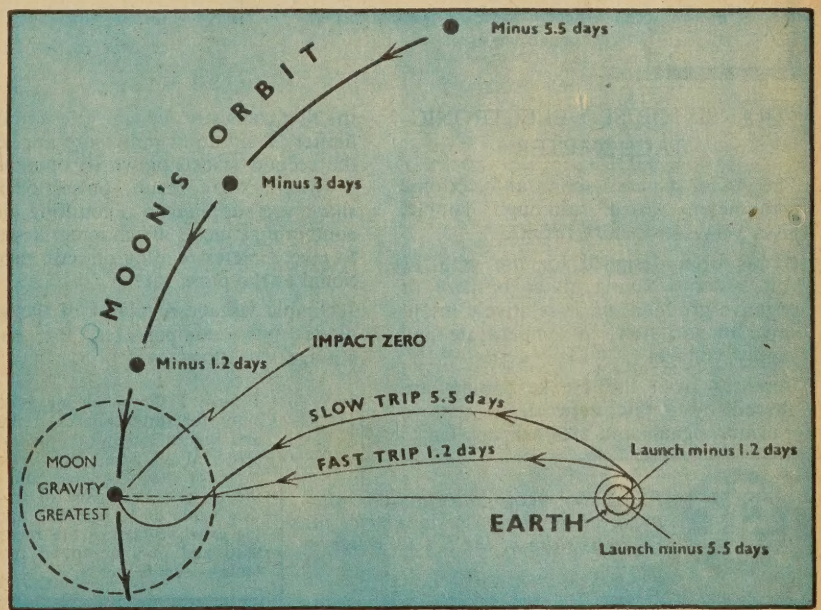

Figure 3: Typical Earth-Moon impact trajectories.

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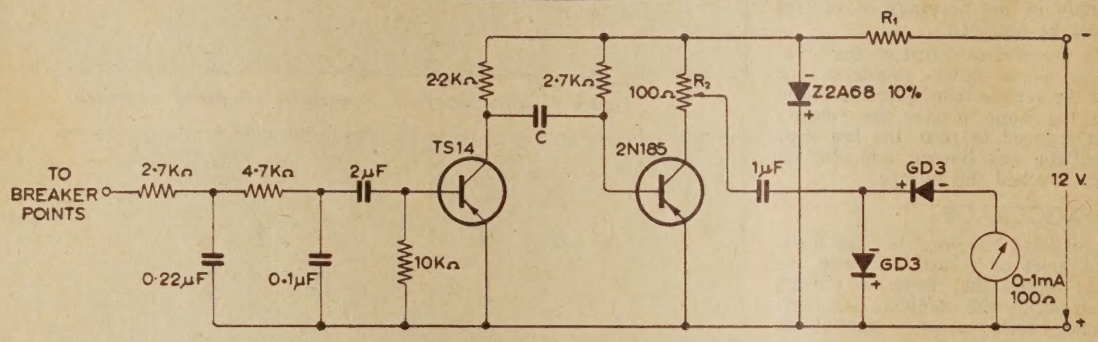
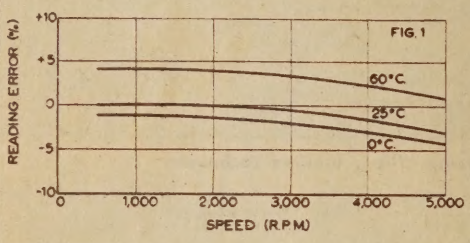
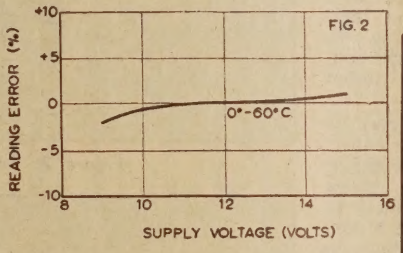


C = 0·5µF FOR 6 OR 8 CYLINDER ENGINES.
= 1·0µF FOR 4 CYLINDER ENGINES.

R_1 - SEE TABLE.
R_2 - CALIBRATION CONTROL.





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Impulses from the breaker points are filtered by a CR network to remove spurious signals and are then applied to the first transistor, which is an amplifier-limiter. The output pulses are applied to the second transistor which operates as a switch. As a result, pulses of fixed shape are supplied to a counting circuit containing a meter which integrates them to give a meter reading directly proportional to the pulse rate.

A simple voltage regulator of the zener diode type compensates for supply voltage variations.

Figure 1 shows the meter reading error for three different temperatures, and Figure 2 shows the meter reading error, at all points on the scale, for a range of supply voltages and over the temperature range of 0°—60°C. The value of R_1 depends upon the exact voltage of the zener diode used and may be found from the table — see Figure 3.

TABLE FIG. 3

Zener diode Voltage (volts)	R_1 (ohms)
6.1 — 6.4	62
6.4 — 6.7	56
6.7 — 6.9	51
6.9 — 7.2	47
7.2 — 7.4	43
7.4 — 7.5	39
7.6	36

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parison between two altitude measurements at a fixed time interval during the main braking descent. Figure 4 shows such a possible sequence of events.

The question whether to use solid or liquid propellants can be answered only after careful consideration of the interrelated effects of propellant performance, system mass and reliability.

With liquid propellants the need is for something storable for the whole of a longish journey. Of the oxidants which reasonably meet this requirement we have hydrogen peroxide, nitric acid and dinitrogen tetra oxide. Hydrazine appears the most likely "storable" fuel to go with the three oxidants.

There is little to choose between them as far as performance is concerned, but they each present problems of material compatibility, handling, and, with the exception of the peroxide, of toxicity.

Hydrogen peroxide-hydrazine has been chosen as the best "storable" combination though it doesn't give the best performance.

STORAGE PROBLEM

Oxygen, fluorine and hydrogen would have to be stored in insulated tanks. With the exception of liquid fluorine and hydrazine the mass penalty involved would appear to rule out their use. (This conclusion is true only for an 800lb vehicle as considered here.)

At the present moment fluorine does not appear a very likely propellant for this application. This is entirely due to its extreme toxicity and chemical activity. It appears most attractive on other counts.

With liquid propellants only two chemical compounds are used at a time, and the number of combinations is, therefore, not large. Solid propellants are usually made up of several compounds. In consequence they are chemically complex. But the physical properties of solid propellants are also of vital concern in estimating their value, and these have to be determined empirically.

The performance, composition and physical properties of high-performance solid propellants are secret, but it seems likely that a performance about 15 per cent less good than hydrogen peroxide-hydrazine is reasonable.

SPECIAL INSTRUMENTS

On the basis of these speculations, I have tried to calculate the quantity of special instruments the Russians might hope to land on the Moon, assuming that a launching rocket similar to that used for Lunik II and Lunik III capable of sending about 800lb to the vicinity of the Moon was used.

I have worked out the figures both for a hydrogen peroxide-hydrazine propellant and a solid propellant braking rocket engine.

In order to simplify the calculations I have had to make certain assumptions —first, that the control and guidance equipment radio transmitters and receivers and power supplies for the entire journey to touch down on the Moon amount to only 180lb, and, secondly, that one-third of the total mass of the vehicle at landing comprises landing gear and shock absorber, the empty propulsion system, and load-carrying structure.

The 800lb of vehicle is then apportioned thus:

	Solid	Liquid
Before firing	800	800
At touch-down	280	370
Control and guidance ..	180	180
Landing structure, etc. ..	93	123
Remainder for instruments	7	67

This comparison underlines one most important point. Within such a tight limit as we are considering, the high-performance propellant pays considerable dividends, the size of special instrument load being 67lb if the liquid propellant is used, as compared with a very meagre figure of 7lb for the solid.

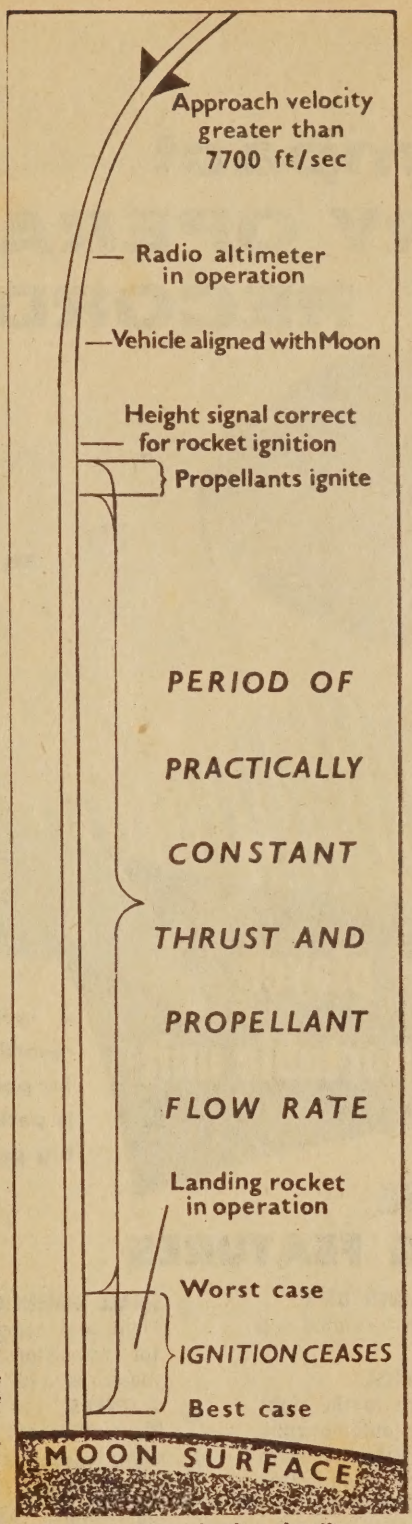

Figure 4: Moon landing details.

Should any one of the assumptions that I have made prove even slightly over-optimistic, then the solid propellant becomes useless. In fact, it appears most unlikely that the solid propellant will be considered as a serious contender in this particular application.

A modern experiment based on a liquid propellant engine would seem to be possible even if the assumptions I have made do prove too optimistic.

Clearly if a decision is made to examine such a program, an extensive part of the feasibility study will centre on the extent to which it is possible to reduce the mass of control guidance, power supply, landing gear, propulsion, and structure.

ATTEMPT SOON?

In the absence of such a detailed study there seems no insuperable reason why the Russians, with their existing skill at launching Moon probes, should not attempt quite soon a soft landing on the Moon.

There still remains one hazard of unknown magnitude. Even the most perfect landing could be spoilt by local lunar defects—potholes full of dust, large boulders and even jagged mountains. It would be a tragedy if, after a successful landing on the moon, the instrument package tumbled to its destruction over a precipice.

NEW HEAT SHIELD

A NEW material capable of protecting man, animals or instruments in flights through space and re-entry into the earth's atmosphere has been developed by the General Electric Company, U.S.A.

An organic plastic substance, the material was developed for the United States Air Force to protect nose cones against the supersonic speeds, searing heat and rigorous mechanical forces encountered in re-entry flight.

The new heat shield material is made in a simplified production process. Basic components are first blended and heated in temperature controlled ovens and mixed to the proper consistency. They are then subjected to an air removal process and poured into moulds.

The material can be made elastic, flexible or hard. In all variations, however, it possesses excellent heat protective qualities. In successful tests, the space shield material was subjected to temperatures of more than twice the surface temperature of the sun.

A major advantage of the new material over presently used protective coatings is its reduced production cost and time.

Laminated and high pressure moulded phenolic materials now used as nose cone thermal shields are difficult and costly to fabricate. Current production systems are also more complicated. In one, the protective material is moulded in high-pressure presses. In another, miles of special impregnated tape are wound around nose cones as a protective outer coating.

In announcing the new material, Dr. Steg said, "The protective qualities of this material should be of special interest to America's astronauts who will rely on an inch or two of material expected to shield them from extremely high temperatures on the return home from space —a voyage of discovery undreamed of less than five years ago."

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A NEW AUTOMATIC MOVIE CAMERA

The energy from solar or light rays has been harnessed to set the lens of a new automatic 8mm movie camera introduced recently by the Bell & Howell Company.

THE new camera is the first in the world in which light energy alone supplies the power to generate the electric current which adjusts the lens. No batteries, motors or springs are used for the exposure setting. The current is transmitted directly from the photoelectric cell to a mechanism controlling the lens iris.

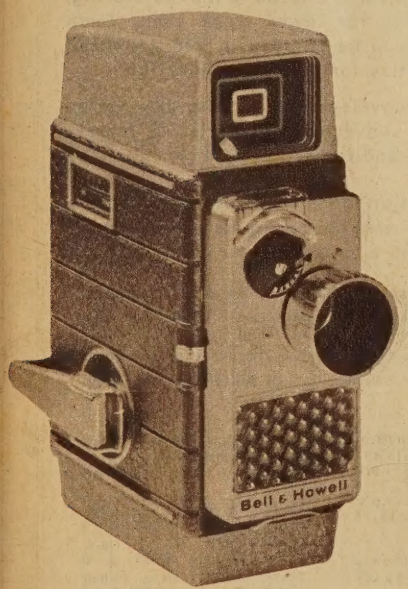
It is also the world's first completely automatic movie camera in 8mm size. The movie-maker winds the camera, sights and shoots. The electric eye, which adjusts to changing light faster than the human eye, sets the lens for proper exposure before the starting button is touched. It can operate the lens though its full range of stops from f/1.9 to f/16 in less than one second.

No focusing is necessary and the camera can be used with indoor or outdoor colour film.

This means that without knowing what an f-stop is, the movie novice can now be sure of properly exposed film every time, a result not consistently achieved by experts.

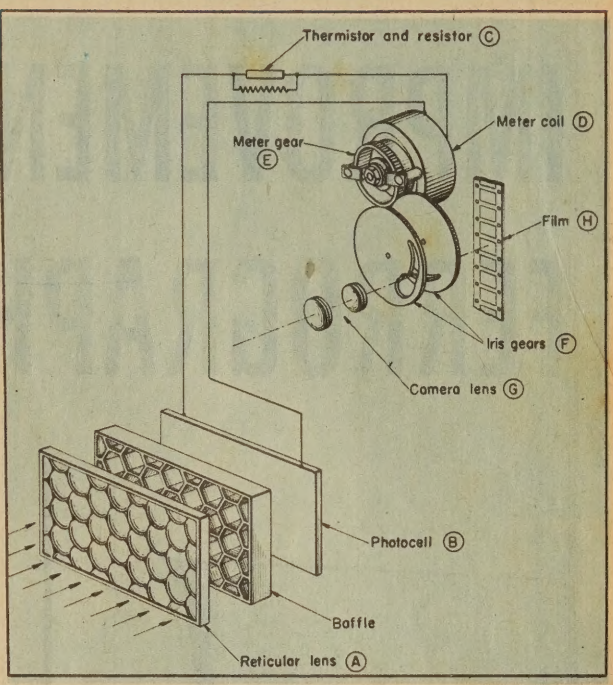
He can also follow a subject from light to shadow, confident that the electric eye is accurately computing the light changes and automatically adjusting the lens. With a conventional camera he would have to interrupt shooting to change the exposure setting.

An amber exposure beacon in the camera's viewfinder glows as long as the available illumination is adequate. It turns black to signal that there is insufficient light for movie-making.



The new automatic camera. Taking lens is a 10mm f/1.9, with wide-angle and telephoto attachments available as extras. Beacon in viewfinder glows to indicate adequate light. Slide filter adjusts for indoor or outdoor color film.

Light enters lens and baffle (A), whose angular coverage matches taking lens. Light reaches the photocell (B) generates current, which passes through resistor and thermistor (C) to compensate for temperature. Current deflects the meter coil (D), gear on meter (E) engages the iris gears to create the iris opening (F).



NEVER WEARS OUT

Like the human eye, which continually adapts to the brightness of the surroundings, the electric eye works continuously as long as light reaches the photocell. It "rests" only in darkness or when there in insufficient light for movie making. It never wears out or weakens under normal conditions.

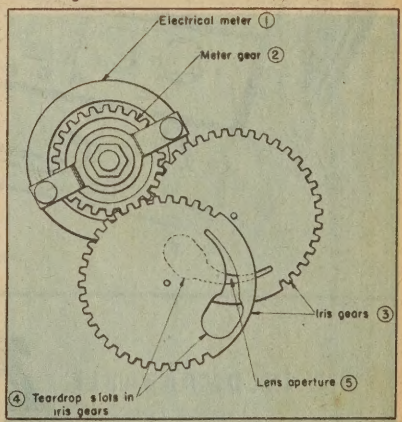
To make feasible the design approach of the electric eye, Bell and Howell engineers developed a new type of lens iris so sensitive that it moves at the touch of a human hair. Yet it is sturdy and shockproof and has withstood vigorous environmental and field tests.

Through the use of thermistors the electric eye mechanism adjusts to temperature changes. The camera can be used at any temperature extremes the film itself will withstand.

Light reflected from the subject enters a reticular honeycomb lens which controls the angular coverage to match that of the camera lens. Upon reaching the photocell, the light generates an electric current which is fed to the meter mechanism. The meter computes the correct exposure and opens or closes the lens as required.

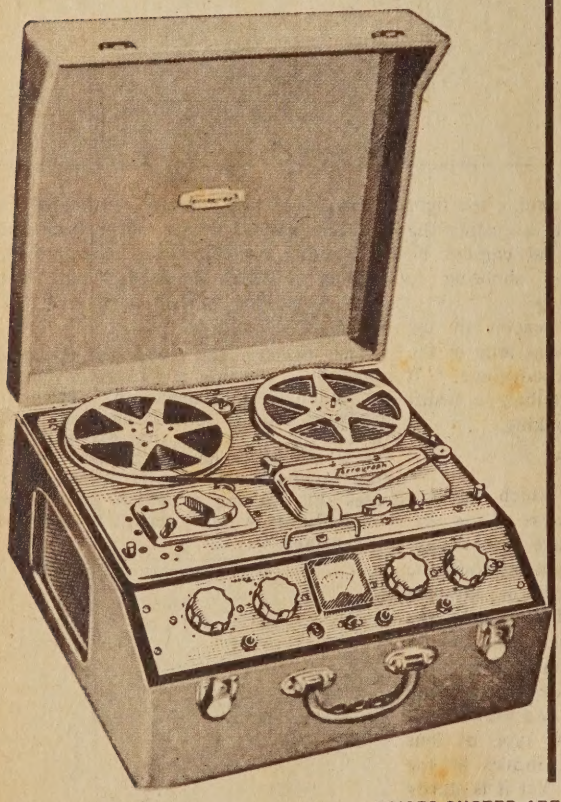
Linked to the control mechanism is a needle pointer which moves back and forth along a visible scale, indicating the opening at which the lens is set. The scale is marked in f/stops of 1.9, 2.8, 4, 5.6, 8, 11 and 16.

The camera can also be operated manually. Turning a dial from "auto" to "manual" disconnects the automatic exposure control so that the lens may be set for under- or over-exposure for special effects. When the camera is operated manually, the needle pointer indicates the opening at which the lens is manually set without regard to the correct exposure.



In the electric meter (1) the meter gear (2) rotates according to the current generated by the photocell, causing a rotation of both iris blades (3). Each iris gear or blade has a "teardrop" slot (4). The point where the slots overlap creates the lens aperture (5).

8 IMPORTANT DESIGN IMPROVEMENTS IN NEW FERROGRAPH SERIES 4



This latest development of the incomparable Ferrograph incorporates several new design improvements and will enable every Series 4 Ferrograph to be readily adapted at any future time for a variety of applications. For example, space has been provided under the Head Cover to permit Head changes and additions for monitoring, stereo playback and for lower track uses. Such heads are designed to be plugged in and are fitted with rocking facilities for azimuth correction.

Also, this new development permits any Series 4A to be instantly converted to a Series 4S merely by plugging in the additional stereo head.

Other important design improvements are:

- The capstan motor is resiliently mounted for quiet operation.
- Function Switch Knob is re-fashioned for greater ease of operation.
- Brief Stop is now a standard fitting on all Ferrographs.
- The Head Cover—a one-piece moulding—is hinged for easy tape loading.
- The Turns Counter—now gear driven—is accurate to a turn.
- New standard colour scheme for all models—2-tone grey.

SERIES 4A
With standard monaural recording/playback facilities.
Model 4A/N 3¾/7½ i.p.s.
Price £239 2 6
Model 4A/H 7½/15 i.p.s.
Price £271 12 6

SERIES 88
With full stereophonic recording and playback facilities.
Model 88 7½/15 i.p.s.
Price £302 7 6

SERIES 4S
With optional stereo sound playback facilities in addition (when used with Stere-Ad Unit).
Model 4S/N 3¾/7½ i.p.s.
Price £268 0 9
Model 4S/H 7½/15 i.p.s.
Price £289 1 8
Stere-Ad Unit (when required) £90 9 0

PRICES QUOTED ARE RETAIL. TRADE PRICES EXTENDED TO BROADCASTING INTERESTS.

THE INCOMPARABLE **Ferrograph**

Demonstrations and supplies available from: **TAPE RECORDERS PTY. LTD.**
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FROM COALFACE TO KILOWATTS

One of the most significant advances in power generation in New South Wales has been the establishment of new power stations on the coalfields, coupled with the development of new fully-mechanised collieries mining relatively low-grade coal at low cost.

THE use of low-grade coal is dictated by availability of large coal reserves, favourable mining conditions and the likelihood that this coal will not be wanted for other purposes.

The reduced transport content so achieved in the cost of coal has appreciably lowered operating costs.

Huntley Colliery, five miles west of Dapto, and Tallawarra Power Station, on Lake Illawarra, form a partnership that exemplifies this important trend.

About 2,300 tons of coal are mined per day at Huntley, which is planned to rise to an average capacity of 3,000 tons per day.

Two coal seams are worked—the Wongawilli, or upper of the two, contributes about 85 per cent of the output from a working height of 8 to 10 feet; and the Tongarra seam, 100 feet below, yields the remainder from a thickness of six feet.

HUGE RESERVE

In these two seams the reserves of recoverable coal are conservatively estimated at 75 million tons.

Entry to the mine is by tunnels on a low gradient following the dip of the seams.

At present, coal emerges from three "entries," one in the Tongarra seam and two in the Wongawilli seam, but planning is now being undertaken to simplify and reduce the cost of coal haulage that would otherwise become unduly high as the workings penetrate further.

Coal is mined at the working faces by machines known as "continuous miners," which eliminate the use of explosives.

These machines cut directly into the coal seam, breaking and loading the coal into shuttle cars, broad-tyred vehicles, which then carry the coal away and self-discharge it on to the nearest belt-head.

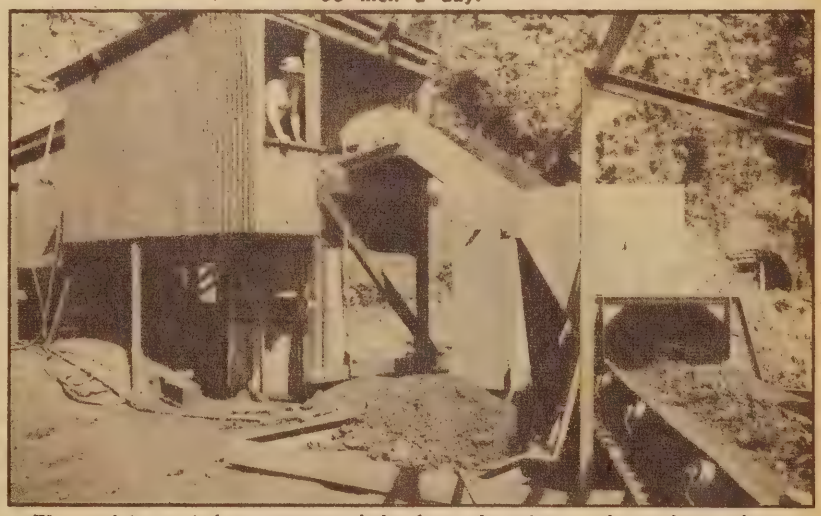
All equipment is electrically driven. As development of the mine proceeds, the installation of belt extensions becomes a regular task.

Coal emerging from the tunnels is crushed to a size suitable for acceptance at the power station and is mostly less than one inch top size.

It passes into bunkers from which it is loaded into road trucks for transport to the power station.

A recently installed bunker at Huntley

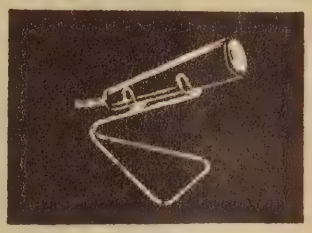
Deep below the surface of the earth, a machine known as a "continuous miner" gnaws coal from the seam at Huntley Colliery, near Dapto. This machine cuts coal at the rate of 2½ tons a minute, doing the work of about 30 men a day.



The coal is carried on conveyor belts from the mine to the surface, where it is crushed to a size suitable for acceptance at nearby Tallawarra Power Station. It then passes into huge bunkers for easy loading into trucks.

Every hour of the day, trucks carrying coal move down the mountain to Tallawarra Power Station, just over seven miles away. Each truck carries a load of 13 tons.

MICROPHONES AND FLOOR STAND



ACOS FLOOR STAND

Tristand for use with all types of stand microphones. Top of the extension arm is ⅝in x 26 TPI std. thread. The base and lower tube is finished in silver varitone, the extension arm being chromium plated.

DIMENSIONS: Base diameter . . . 17 inches. Height . . . Min. 3ft 3in. Max. 5ft 6in. Weight . . . 11 pounds.

PRICE £5-6-0.

CRYSTAL STICK MICROPHONE, MIC39-1

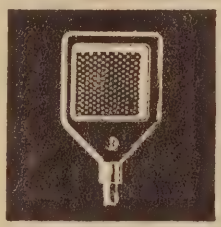
The MIC39-1 has been beautifully styled as a hand, desk stand or floor stand unit, and precision engineered to the highest professional standards. A heavy die-cast liner in the microphone case eliminates the possibility of hum pick-up due to hand capacity effects. The use of a special noise-free cable improves screening and gives a greatly increased signal-to-noise ratio. Designed especially for high quality recording, broadcasting and public address work.

PRICE £8-19-6, complete with desk stand.

CRYSTAL MICROPHONE MIC40

The MIC40 has been pleasantly styled in a variety of two-tone colours to give a handsome quality Microphone of modest dimensions and unassuming price. Ideal for tape recorders with a minimum of stowage space available, and a wide range of domestic applications.

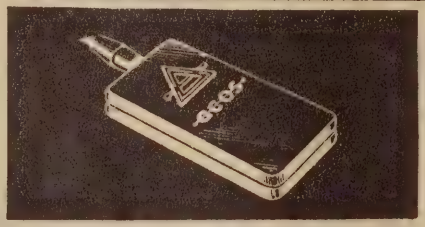
PRICE £3-19-6.



LAPEL MICROPHONE MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

PRICE £5-19-6



STRINGED INSTRUMENT AMPLIFIER, TYPE VP1.

The VP1 Vibro-Voice has been specially designed for use with guitars, double bass and in fact all stringed instruments. With the use of this simple yet effective pick-up together with a good quality amplifier any instrument can be amplified. The VP 1 has an ample output and a frequency range which extends to approx. 5 K/cs. The tough rubber case protects the instruments from damage. Easily connected to the PU input of your amplifier or radio with a resistance of 5 megohms in series with the inner core of the cable.

PRICE £7-15-0.

ACOS PILLOTONE

Replaces irritating headphones and enables the individual listener to relax, head comfortably settled on a cushion or pillow. Although giving the reproductive qualities of a normal loudspeaker the Pillotone is inaudible three yards away. The tone has been specially compensated to give perfect reproduction, the muffling effect of the pillow provides the correct base response. Apart from domestic use the Acos Pillotone is ideal for hospitals and can be completely immersed in disinfectant without harm to the unit.

PRICE £6-10-0.

Sole Australian Agents:

AMPLION (A'sia) PTY. LTD. 101 Pyrmont Bridge Rd., Camperdown. Sydney, N.S.W. Phone LA 6124.

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

south entry can fully load a 13-ton truck in just over a minute by means of a push-button, hydraulically-operated door at the bottom of the bunker.

Roal transport of the coal is done under contract by a fleet of trucks.

Five miles of the total distance of seven and a half miles is over a partly-private but mainly public road, for which the cost of maintenance is borne by the colliery.

Coal is weighed over the Huntley weighbridge and also at Tallawarra Power Station.

In a large colliery it is essential to know something of areas from which future production will come.

Intrusions of rock into the coal seams, volcanic in origin, known as "dykes," are common and cause at times severe cindering of the coal nearby.

These, up to 100 feet in thickness, must be penetrated in developing the mine.

SEAM FAULTS

Faults, or relative displacements of the coal seams in a vertical plane, occur, together with variations in thickness and quality of the workable coal.

Geological survey and aerial photographs yield valuable information on the likely positions and directions of faults and dykes.

When the trucks from Huntley Colliery arrive at Tallawarra Power Station, the coal they bring is tipped through a grating into a hoper.

Although the hopper is being continually emptied by a vibratory feeder on the two conveyer belts, each with a capacity of 250 tons an hour, the arrival of the trucks is timed to keep the hoppers nearly filled.

The conveyor belts lift the coal about 90 feet above the ground through two transfer houses into a coal bunker in the power station.

The bunker is divided into four sections, one for each of the four boilers in the station.

The coal drops through a chute, controlled by a valve, into a coal weigher.

Every quantity of coal which goes into the boilers is weighed at the power station to check coal consumption and station performance.

The coal passes through the weighers into a pulverising mill.

SUPERHEATED STEAM

The coal is fed on to a rotating table and passed under two huge rollers, where it is ground to a fine powder.

During this process the powdered coal is also dried and then mixed with hot air.

The powdered coal is drawn from the mill by an exhaust fan and fed into the combustion chamber of a furnace.

The furnace heats water to supply the turbine with super-heated steam, and the turbine in turn drives a rotary alternator which generates electricity.

Each furnace at Tallawarra Power Station consumes about 400 tons every 24 hours.

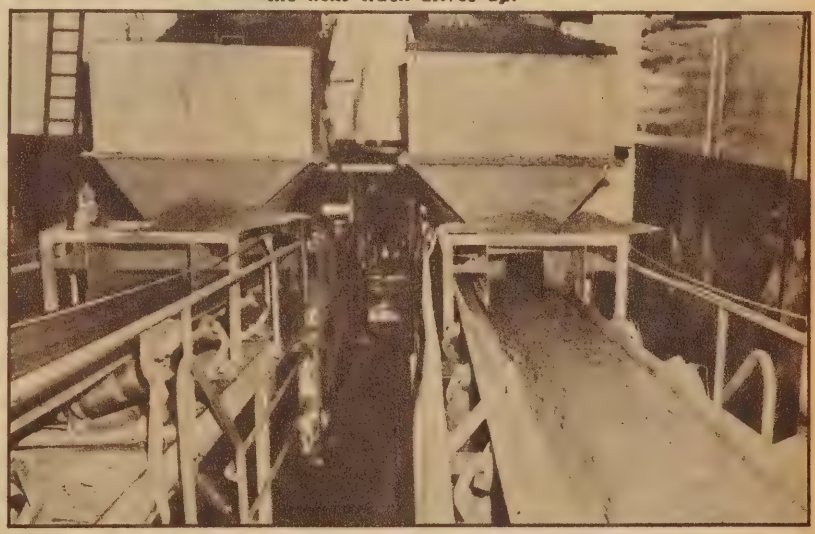
There are four furnaces, consuming 1,600 tons a day between them.

These drive four generators to produce about 3,000,000 kwh of electricity per day.

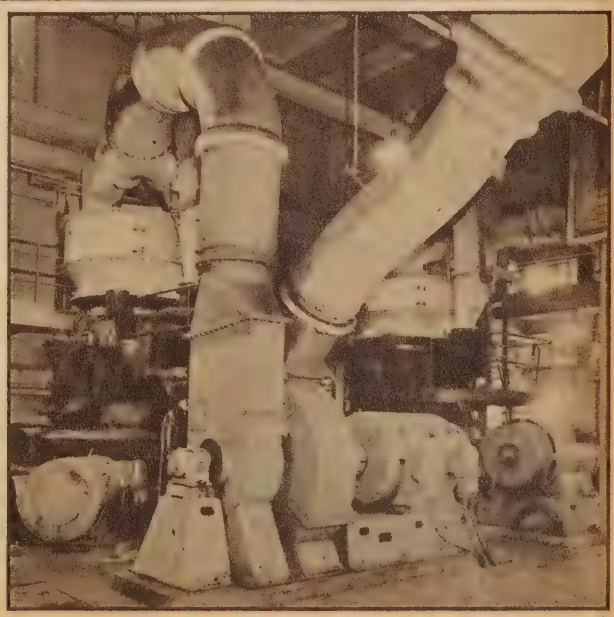
Every load of coal delivered to the power station is sampled and regular tests are carried out in a laboratory at the power station.

COAL REACHES POWER STATION

Arriving at the power station, the truck empties its load of coal through a grating into a large underground hopper. The hopper clears itself before the next truck drives up.



From the hopper, the coal is carried on conveyor belts into Tallawarra Power Station. These belts lift the coal about 90 feet above ground, and pass it through two transfer houses before emptying it into the bunker.



After being weighed, the coal is fed into pulverising mills, like the one at right, where it is ground to a fine powder, dried, mixed with hot air, and blown into the furnace of a boiler. The boilers produce superheated steam.

PHILIPS

new

Multimeter

40,000 Ohms per Volt DC sensitivity has been made possible by a new method of meter movement supension enabling sturdy construction of the 25μA meter.

The instrument features:—

1. **40,000Ω/V DC voltage sensitivity**
2. **Protection against overload.**
3. **Current transformer for AC measurements.**
4. **Low to high ohms ranges.**
5. **Light construction for portability.**

28 Ranges

DC

Volts 0-60 mV to 0-1200V (with EHT Probe 0-30 KV) Current 0-30μA to 0-3A.

AC

Volts 0-3V to 0-1200 } 30 c/s -
Current 0-600μA to 0-3A } 10kC/s

OHMS

0-1000Ω 0-100 KΩ 0-10 MΩ

Carrying case with shoulder strap is available

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P2080/59

NEW ELECTRONIC SPACE CAMERA

A radically new and simple electronic space camera that can take a continuous strip of weather pictures around the world and turn them into television signals for broadcast to the ground, is under development by the Radio Corporation of America for satellite use.

THE new camera is based on a combination of television and electronic printing techniques. It was described by scientists of R.C.A.'s Astro-Electronic Products Division at the convention of the Society of Motion Picture and Television Engineers, held at the Hotel Statler in New York.

The presentation was one of several by staff members of the R.C.A. division on a number of space electronics studies and developments.

Among the others were discussions of proposed television techniques for exploration near and on the surface of the moon, transmission of pictures from space vehicles, and satellite image sensing systems.

The new space camera, under development, is a compact, single unit whose basic elements are a specially-developed electrostatic tape and an electron gun of the type employed in conventional television camera tubes.

In the laboratory model described at the convention, the elements are built into a glass vacuum tube roughly similar in shape to a mushroom.

The "stem" is a television pick-up tube containing the electron gun. The "head" contains the roll of electrostatic tape mounted in an automatic assembly for winding and re-winding during exposure and read-out, somewhat in the manner of standard motion picture film.

SEVERAL ADVANTAGES

According to the R.C.A. scientists, the new camera has several potential advantages for remote viewing of terrestrial clouds or the moon's surface from space. Among them, they mentioned these characteristics that have either been achieved or can be expected with further development:

1. Extreme simplicity and durability, in contrast to systems combining television cameras and magnetic tape storage.

2. Very large picture capacity, based on the ability to erase and re-use the tape after each passage, in contrast to photographic film.

3. Reduced sensitivity to radiation effects in space.

4. Widely variable speed of operation, ranging potentially from a few pictures per orbit up to picture-taking speed comparable to the 16-per-second rate of 8-millimetre motion picture film.

Discussing the speed and capacity of the camera, the lecturers said that the device can be designed to carry various quantities of tape up to several hundred feet.

As an example, they stated that a continuous strip of pictures showing cloud formations completely around the earth could be contained in 180ft of tape — an amount that could be carried in a camera only slightly larger than present laboratory test models.

Moreover, they said, the complete photographic record could be read out of the system and transmitted to the ground within the 5 to 10 minutes during which the satellite was within range of a particular station.

The principles and operation of the new electronic camera were described this way:

Installed in a satellite or space vehicle the camera unit would be associated with a lens system of a type used in conventional photography, and a low-power transmitter to broadcast the picture information to earth.

The tape consists of thin layers of conducting, photo-sensitive, and insulating materials on a transparent base, giving it an appearance similar to that of motion picture film.

Before each exposure, the area of tape unrolled before the lens is given a uniform electrical charge by "flooding" from the electrongun at the rear of the tube..

When the exposure is made, the charge is driven from the tape in accordance with the intensity of light in the scene viewed through the lens. The result is an electrical charge pattern on the tape, corresponding to the light pattern of the image.

The tape can then be moved ahead automatically for the next exposure, storing the image until it is to be read out.

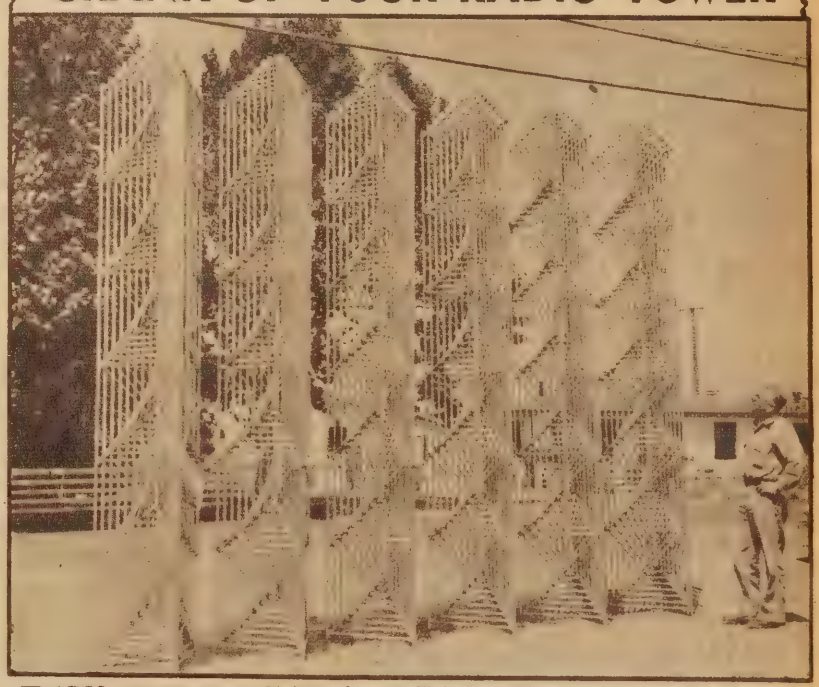
In laboratory tests, images have been stored in this fashion on the tape for up to two weeks without noticeable deterioration.

When the pictures are to be sent to earth, the automatic winding mechanism is reversed. The exposed tape passes before a scanning beam from the electron gun, which "reads" the electrical charge pattern to produce television-type signals for transmission to the ground station.

It was pointed out that the read-out process does not completely destroy the charge image on the tape, so that a picture can be read out several times, if desired, before the information becomes illegible.

When the tape is to be re-used, however, the "flooding" beam from the electron gun removes all traces of the previous image, leaving the tape entirely clear for a new exposure.

CRANK UP YOUR RADIO TOWER



RADIO amateurs and Civil Defence officials can carry a nested 40-foot radio tower in their station waggon or on top of a car, then crank it up to full height when they wish. The collapsible aluminium tower weighs 50 pounds and can be extended for use in five minutes. An ingenious system of cord-operated levers locks or unlocks each section of the tower as it is raised or lowered.

The towers are engineered to withstand 100-mile-per-hour winds when properly guyed and can be lowered at once when high winds are expected. Among other purposes, they are used for temporary lighting stands and for public-address systems. One U.S. railroad company mounts a collapsed tower on a rail car, then erects the ower at various points along its right-of-way to check the signal reception of the division's radio transmitter.

Another kind of aluminium crank-up tower, 60 to over 100 feet tall, is assembled on the ground, and then erected by one man in less than an hour, with the aid of a short boom or spar pole.

A modern, automatic, electrically operated card punching machine. The verifying machine is very similar to operate and shows a red light if the card being checked is not accurately punched.

answer to its own problems, and those of commerce in general, by the development of the punched card tabulating machine.

The use of a punched hole in a card to denote something is, of course, not new. The simplest application is perhaps a bus or tram ticket, which is a printed form containing certain information.

When the conductor sells the ticket, he punches a hole in a particular portion of the ticket to indicate the number of sections the holder is entitled to travel for the money paid.

In this case the hole does not initiate any subsequent functions other than the traveller being thrown out of the vehicle for travelling a greater distance than allowed, if the ticket is inspected.

An example of holes in cards or rolls of paper, which actually set a train of events in motion, is found in the player piano roll. Holes representing the musical notation allow air to be drawn through tubes to operate the keys and pedals of a suitably adapted piano.

PUNCHED ROLL TYPE SETTING

There is a similar application of the punched roll in the mechanical setting of type in the more complicated monotype machine.

Here the holes represent the letters of the alphabet, together with punctuation marks, and all the figures of the language. Other holes represent spacing, margins and so on. A whole page of a book can be punched into a roll of paper, which then operates the monotype machine in such a way that it sets up the page complete with words, spacing, punctuation marks and margins ready for the printing press.

As long ago as 1728, the weaving loom, invented by Jacquard, made use of a punched card, where the position of the holes expressed a pattern which could be mechanically sensed by the weaving machine.

Over one hundred years ago, the great British mathematician Charles Babbage, invented his Difference Engine.

COMMERCE-AND A PACK OF CARDS

Many of us are given to grumbling about being a mere cipher, or a cog in a machine. It might be closer to the truth to suggest that we are just a pattern of holes in a piece of cardboard. With this comforting thought, you can read on.

By Calvin Walters—Part One

THROUGHOUT the civilised world, particularly in highly industrialised countries, the problems of management are becoming more and more complex.

This is due to the extraordinary progress which has been made in production techniques, the continual invention of new products and new discoveries of science.

Even in the year 1949, the American Atlantic Monthly said, "research publication has been extended far beyond our present ability to make real use of the record. The summation of human experience is being expanded at a prodigious rate and the means we use for threading through the consequent maze to the momentarily important item is the same as was used in the days of square rigged ships."

This means, of course, that if, from the vast bulk of the ever-expanding mass of information, it is desired to find one particular item, the old methods in use for sorting and through the files are far too cumbersome.

DATA SYSTEMS VITAL

In fact so true was this that, without some new filing and sorting technique, the usefulness of scientific research threatened to become impaired.

The highly competitive nature of the fields of consumer goods production and sales makes it imperative that management has the means for fast sorting, tabulating and analysing the position at any given period.

In large measures, scientific research has found the

In order that the operation of the machine could be properly set in motion, Babbage used punched cards for representing numbers to it in a form which it could understand.

The greatest advance in the use of punched cards took place towards the end of the last century, during the taking of the American Census of 1890.

At that time the previous census was still being tabulated when the time came for taking the new one.

NEW METHOD ESSENTIAL

The manual tabulating of all the information taken in a census is a task of great magnitude, requiring years of labour. Because of the rapid growth of American population at the 1890 Census, a new means was required of recording the data obtained.

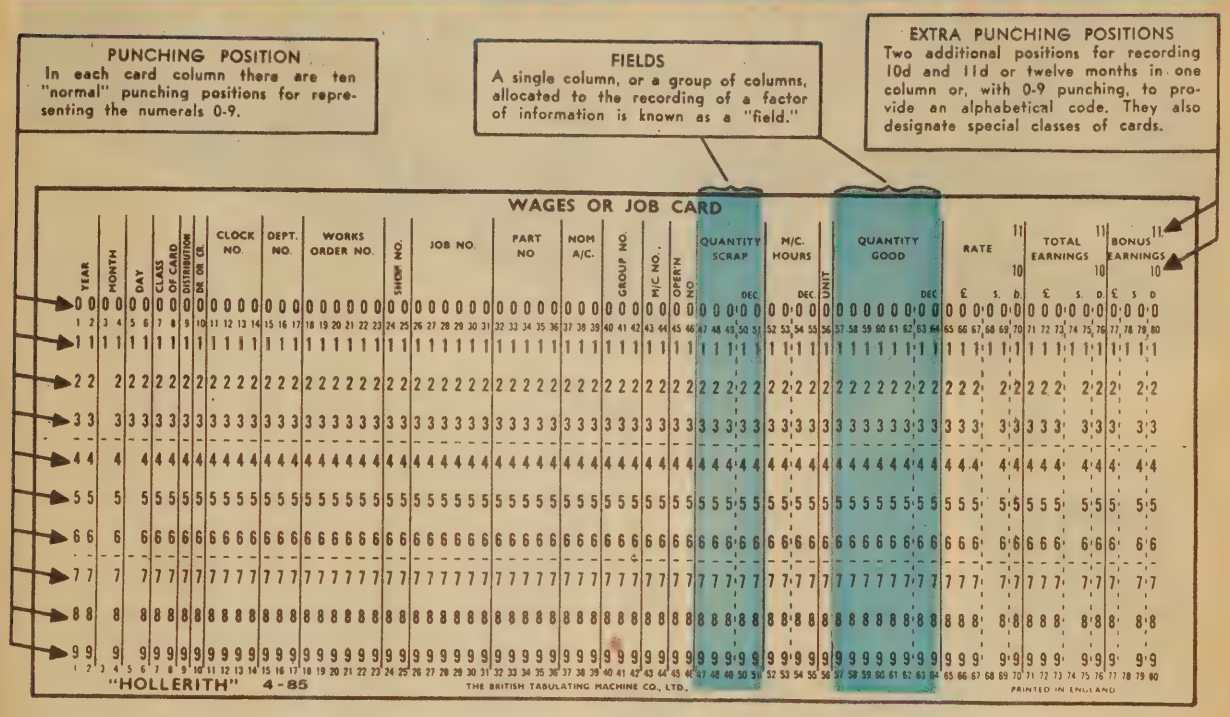
Dr Hermann Hollerith set about the task and came up with the punched card machine, using holes in cards which could be electrically sensed and translated.

Later James Powers devised a similar system where the holes in the cards were sensed by delicate mechanical probes. The final result was the same in both machines.

In the Hollerith machine the cards are continually moving whilst being "sensed," whereas in the Powers machine the cards must be held stationary for a fraction of a second while the probes enter the holes and withdraw.

In any transaction, where information is recorded, the operations required for a complete record are firstly

TYPICAL CARDS BEFORE AND AFTER PUNCHING


PUNCHING POSITION
In each card column there are ten "normal" punching positions for representing the numerals 0-9.
FIELDS
A single column, or a group of columns, allocated to the recording of a factor of information is known as a "field."
EXTRA PUNCHING POSITIONS
Two additional positions for recording 10d and 11d or twelve months in one column or, with 0-9 punching, to provide an alphabetical code. They also designate special classes of cards.
WAGES OR JOB CARD
YEAR
MONTH
DAY
CLASS OF CARD
DISTRIBUTION DR. OR CR.
CLOCK NO.
DEPT. NO.
WORKS ORDER NO.
SHOP NO.
JOB NO.
PART NO
NOM A/C.
GROUP NO.
M/C NO.
OPER'N NO
QUANTITY SCRAP
M/C. HOURS
UNIT
QUANTITY GOOD
RATE
TOTAL EARNINGS
BONUS EARNINGS
"HOLLERITH" 4-85
THE BRITISH TABULATING MACHINE CO., LTD.
PRINTED IN ENGLAND

Here is a typical unpunched 80-column card. Arrows indicate punching position and also "fields."

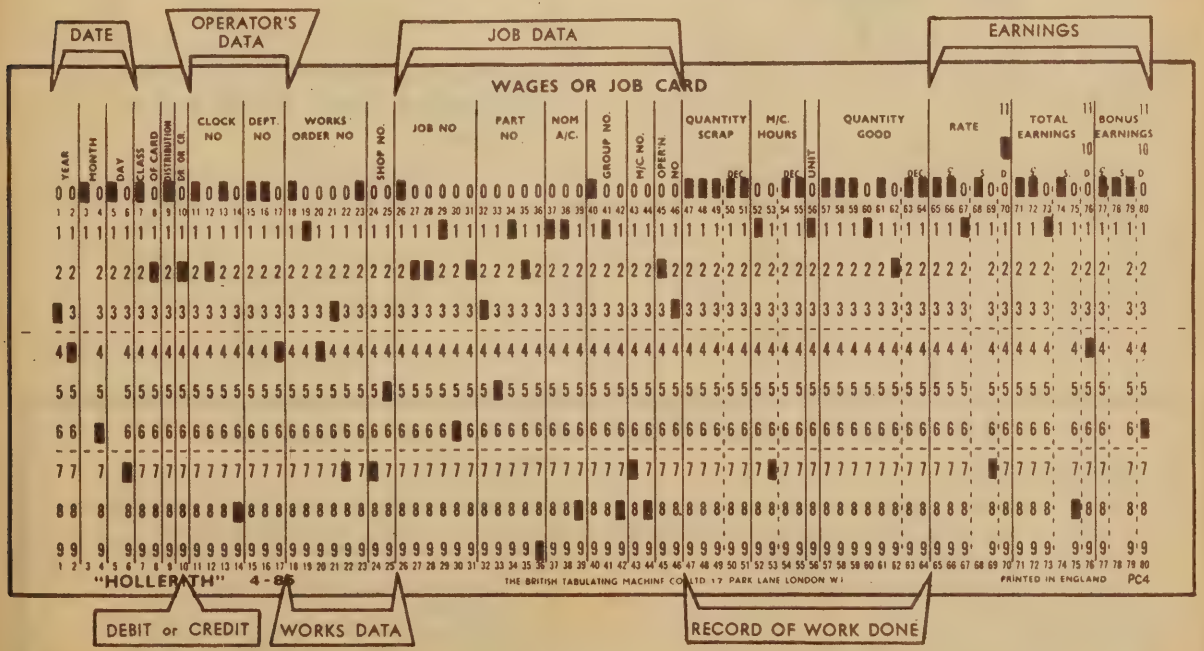
to originate, then to copy, select, collate, compute and write or translate. Modern punched card machines do all these things at a speed which is fantastically greater than is possible by manual work.

Because of the widespread interest in punched card systems, I propose to detail the general principles involved and to describe some of the most important machines in use.

For much of the technical information and the diagrams given, I am indebted to I.C.T. (Australia) Ltd., makers of the Hollerith and Powers-Samas equipment.

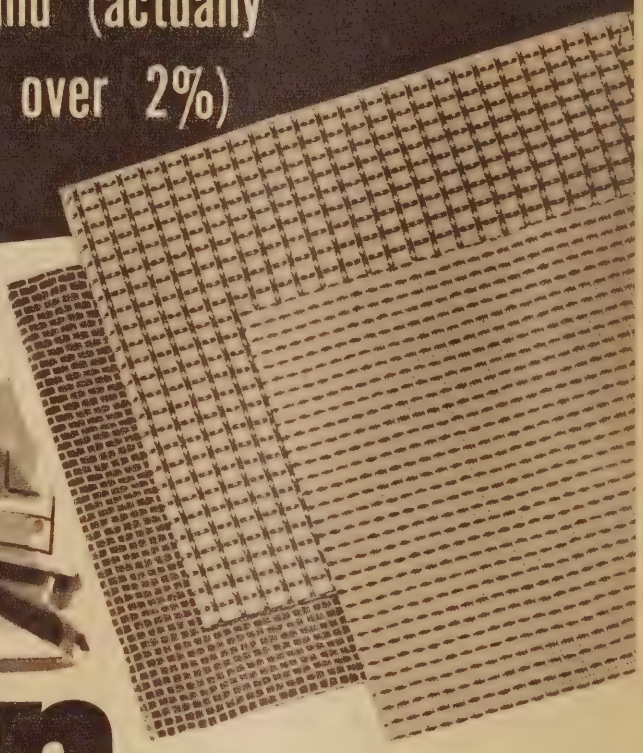
The principles of punched card operation are not at all difficult to understand, contrary to general belief, so let's get started by first taking a look at a typical card.

Cards are used in several sizes, the most popular being 3¼ inches by 7 3/8 inches. They measure approximately 150 cards to the inch in thickness and are made of



The same card, here used to assess factory costs, has been punched to record typical data. Labels indicate how the information has been arranged.

At last! A beautiful speaker fabric that does not absorb sound (actually increases volume by over 2%)



Tygan High-Fi Fabric

Available in literally hundreds of colours, designs and weaves, Tygan High-Fi Fabric can make *your* set more beautiful. *Tygan is the most efficient speaker fabric ever.* Independent laboratory tests on the sound absorption characteristics of a variety of fabrics and fibres were recently conducted in the U.S. In reporting the results of these tests "American Fabrics" said that when an ordinary fabric was placed over the speaker the volume was reduced and the fidelity impaired. When Tygan High-Fi Fabric was placed over the speaker, an increase in the volume of up to 2% was noted. This is because Tygan does not absorb sound and even reflects some back into the speaker.

It's so easy to put a beautiful Tygan Fabric onto your set—it only takes about thirty minutes work.

IMPROVED FIDELITY IN HIGH-FREQUENCY RANGE UP TO 14,000 CYCLES

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Radio Despatch Services, 841 George Street, Sydney.
United Radio Distributors Pty. Ltd., 175 Phillip Street, Sydney.

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Electronic Developments, Nicholas Buildings, 37 Swanston Street, Melbourne.
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Gerard and Goodman Ltd., 192-196 Rundle Street, Adelaide.
Newton McLaren Ltd., Leigh Street, Adelaide.
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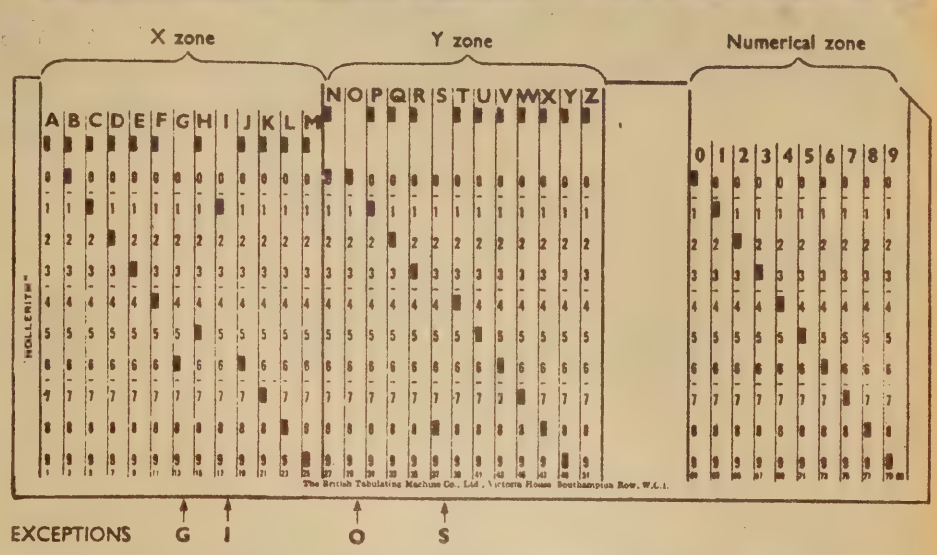
stock which is strong and capable of standing up to considerable handling.

The card is printed with 80 columns of the numbers from 0 to 9, thus giving 10 rows of figures. There are also two rows above the 0, namely 10 and 11, but these are printed on the card only when required for money columns.

They are available in other columns for other purposes, as will be seen later.

It will be seen that the columns are numbered at the top and bottom from 1 to 80. This is for quick reference to the columns by the operator and the designer of the card for a particular purpose.

Each card is printed specially for the job it has to do. In all cases, the 12 rows of numbers are available, although, for some purposes, it is expedient to print only the 0, 3, 6 and 9 rows on the body of the card, the number 1 column only being complete as a guide to position.


PUNCHING HERE INDICATES LETTERS
X zone
Y zone
Numerical zone
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
0 1 2 3 4 5 6 7 8 9
HOLLERITH
The British Tabulating Machine Co., Ltd., Victoria House Southampton Row, W.C.1.
EXCEPTIONS G I O S

Though some of the smaller figures have unavoidably suffered in the reproduction, this diagram shows how a hole pattern can signify letters of the alphabet.

The card is further divided into distinct parts, consisting of a single column or a group of columns within which it is desired to record some factor of information. These columns are called "fields."

A glance at the illustration will make this quite clear. The card depicted is a wages or job card where the fields are clearly marked. The lower illustration is the same card after it has been punched with the required information.

Column 1 and 2 is the field for the year of the date. Column 3 and 4 is for the month. Column 5 and 6 is for the day.

You will notice that the 3 has been punched out from column 1 while the 4 has been punched out from column 2. The year is thus 1934 (34).

Next the 0 has been punched from column 3 and the 6 from column 4. The month is therefore June (given as 06).

Similarly, with the day, which has been punched 07 or the 7th day. The date is thus the 7th day of June, 1934.

When a unit figure is required in a 2-column field, the first column is always punched with a nought, the second column showing the units figure. Similarly with a field of any number of columns.

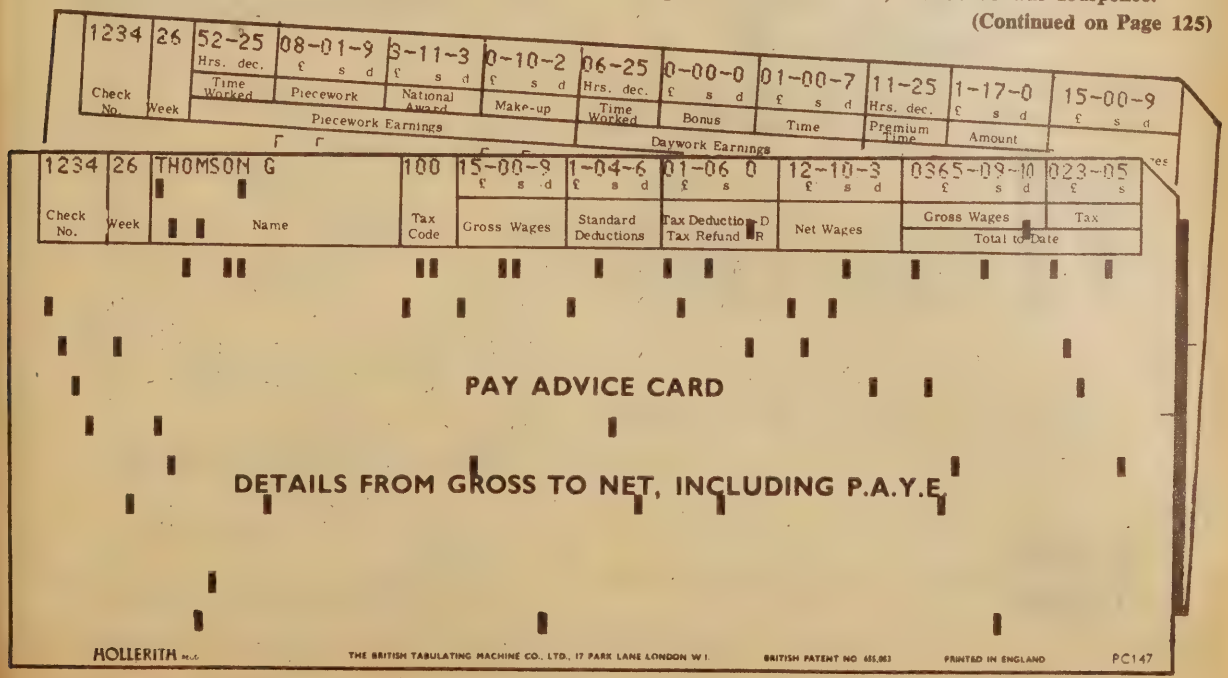
Now cast your eye over to the money columns on the right hand end of the card under the headings Rate, Total Earnings and Bonus Earnings. The latter is of considerable interest to a lot of people. You get a bonus or you don't.

In the Rate field, the pounds column reads 001, the shillings 07, while the 10 is punched from the card near the top of column 70. Translated, this amount reads £1/7/10.

The same applies to the Total Earnings field. The amount is punched 001 pounds, 08 shillings and four pence (£1/8/4/).

Bonus Earnings is punched 0 pounds, 00 shillings and fourpence. In other words, the bonus was fourpence.

(Continued on Page 125)


1234 Check No.
26 Week
52-25 Hrs. dec. Time Worked
08-01-9 £ s d Piecework
3-11-3 £ s d National Award
0-10-2 £ s d Make-up
Piecework Earnings
06-25 Hrs. dec. Time Worked
0-00-0 £ s d Bonus
01-00-7 £ s d Time
11-25 Hrs. dec. Premium Time
1-17-0 £ s d Amount
15-00-9 £ s d
Daywork Earnings
1234 Check No.
26 Week
THOMSON G Name
100 Tax Code
15-00-9 £ s d Gross Wages
1-04-6 £ s d Standard Deductions
01-06 0 £ s Tax Deduction D Tax Refund R
12-10-3 £ s d Net Wages
0365-09-10 £ s d Gross Wages
023-05 £ s Tax
Total to Date
PAY ADVICE CARD
DETAILS FROM GROSS TO NET, INCLUDING P.A.Y.E.
HOLLERITH
THE BRITISH TABULATING MACHINE CO., LTD., 17 PARK LANE LONDON W.1.
BRITISH PATENT NO 655,863
PRINTED IN ENGLAND
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Here punched information has been automatically typed on to the top of the card, so that the details can be read off directly.

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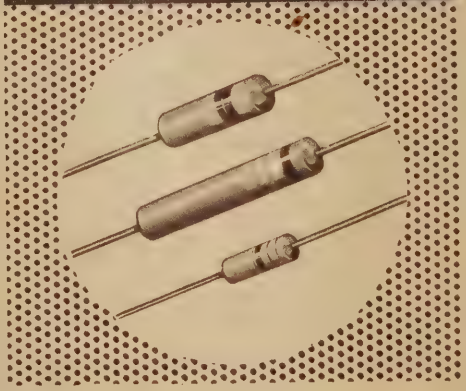

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Technical Review

HIGH-SPEED COMPUTER TO ANALYSE HEARTBEAT

The U.S. Bureau of Standards has developed a method for using computers to compare and analyse heartbeat information, in work sponsored by the Veterans' Administration. It represents an important advance over present methods which rely a great deal on memory and observation.

MAKING use of magnetic tape to record heartbeat data and a high-speed digital computer to compare these records, the method can help a physician in making an objective diagnosis of a patient, and it represents an important step toward using a computer to study heart disease.

The method (1) was developed by L. Taback, Ethel Marden, and Dr H. L. Mason of the Bureau's data processing systems laboratory with the co-operation of Dr H. V. Pipberger of Veterans' Administration Hospital, Washington, D.C.

Althought much work has been done on the relationship between heart diseases and electrocardiograms, diagnostic methods remain largely empirical.

Thus it is desirable to analyse a greater number and variety of heartbeat records so that more accurate limits can be set for normality.

The present work shows that adequate statistical studies are feasible when use is made of magnetic tapes and high-speed computers.

These tapes have the advantage of being able to store large amounts of data, and they can be used quickly and efficiently to retrieve old records in a form suitable for comparison.

The prototype equipment designed and assembled at the Bureau performs what is essentially a conversion process.

In this process, heartbeat data recorded on magnetic tape as continuous waveforms (electrocardiograms) are changed to numerical (digital) form, and the resulting numbers are recorded on another magnetic tape in a form acceptable to the computer.

These numbers represent the electrical signals associated with the heartbeat.

In a computer these numbers can be quickly compared with a normal record for diagnostic purposes, or with various factors among groups of patients for statistical purposes.

As recorded from a patient for this VA research program, an electrocardiogam is a series of 3 continuous waveforms, substantially repetitive with each heartbeat.

These waveforms approximate the 3 mutually perpendicular components of the heart vector, as obtained from electrodes placed on the head, chest, and ankle of the patient.

They are not suitable for use in a digital computer until they have been changed from analog (continuous-wave) to digital form.

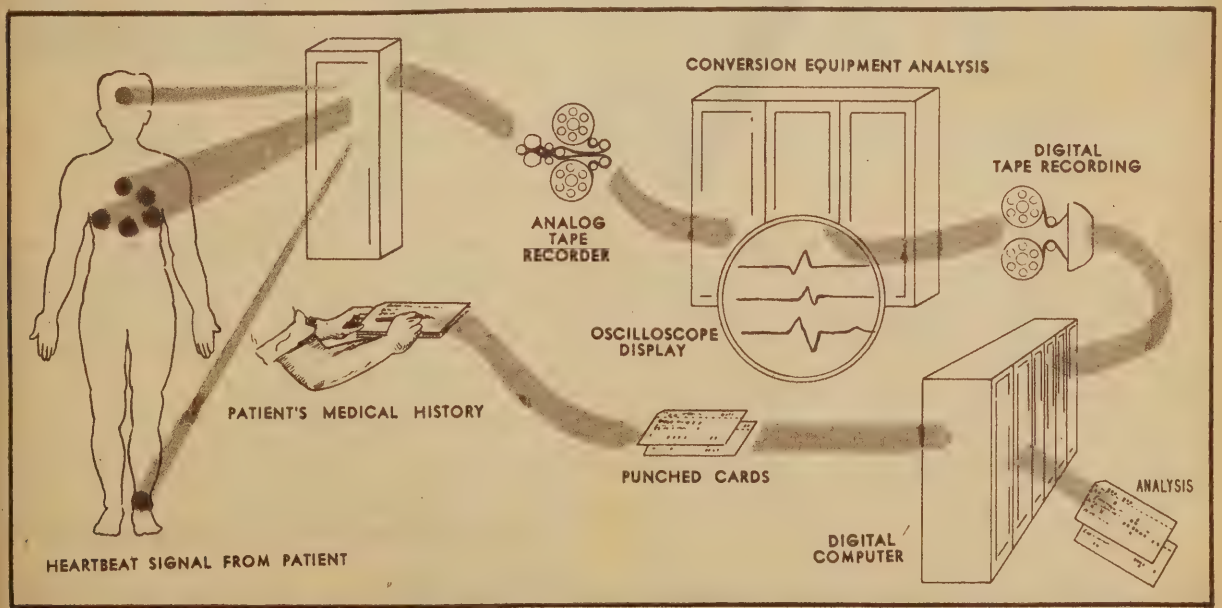
TYPICAL INFORMATION

When ready for conversion, the analog tape recording contains 10 or 12 heartbeats on 3 FM channels, and the patient's identification on 1 voice channel.

The VA chose wide-deviation FM for recording the heartbeat signals because the frequencies to be studied fall between direct current and 200 cps.

A medical technician monitors the 3 signals displayed simultaneously on an oscilloscope and selects a cardiac cycle for conversion to digital form.

The display is independent of the heart rate and need not be readjusted for each patient. If desired, the operator can



Flow of information for converting heartbeat signals for analysis in a digital computor.

NEW Audio Amplifier Manual

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reverse the tape and replay the record. Normally only 1 cardiac cycle is converted for analysis.

When heartbeats appear erratic, however, the technician may record more than 1 cycle. By means of a manual selector and a "record" button, the digital record is made in only a few seconds.

In the conversion process, data are sampled periodically. Each of the 3 analog waveforms is sampled 1,000 times each second, and a binary number is formed by the converter to represent the magnitude of each wave at the time of sampling.

These magnitudes are recorded on digital magnetic tape, to be used in a high-speed electronic computer either for comparison with a normal record or for cross-correlations.

ONE REEL OF TAPE

Approximately 1,000 cardiac cycles can be recorded in this manner on one reel of digital magnetic tape. The data could also be printed out on punched cards or plotted on paper charts.

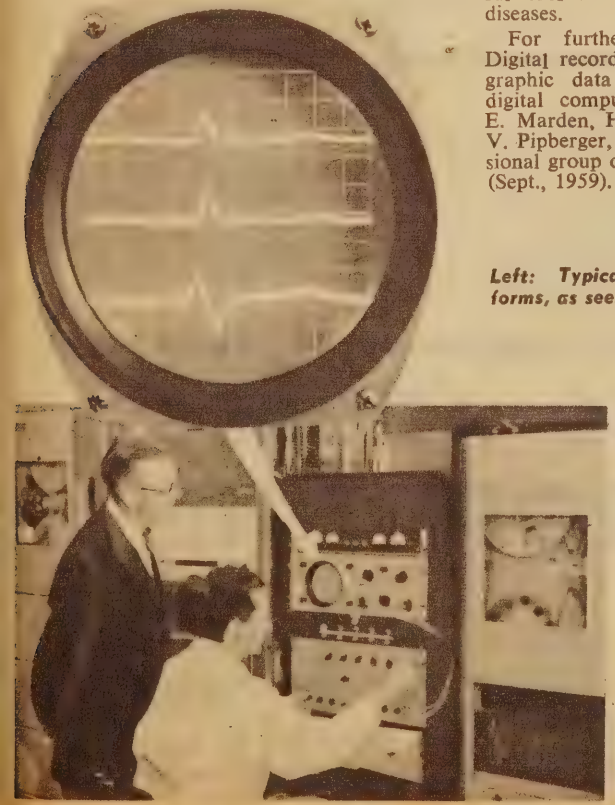
Digital tape records have been made of heartbeat information of several hundred patients, and the Veterans' Administration plans to record additional information concerning these patients on punched cards so that statistical correlations can be made.

Data from VA hospitals will be processed in a central installation at Mount Alto Hospital, Washington, D.C.

With additional experience in digital transformation, this digital recording system may be expanded to include other clinical data such as phonocardiograms and hemodynamic pressures and flows.

The use of high-speed computers for both diagnosis and statistical analysis of these data should prove a powerful tool for the study of heart diseases.

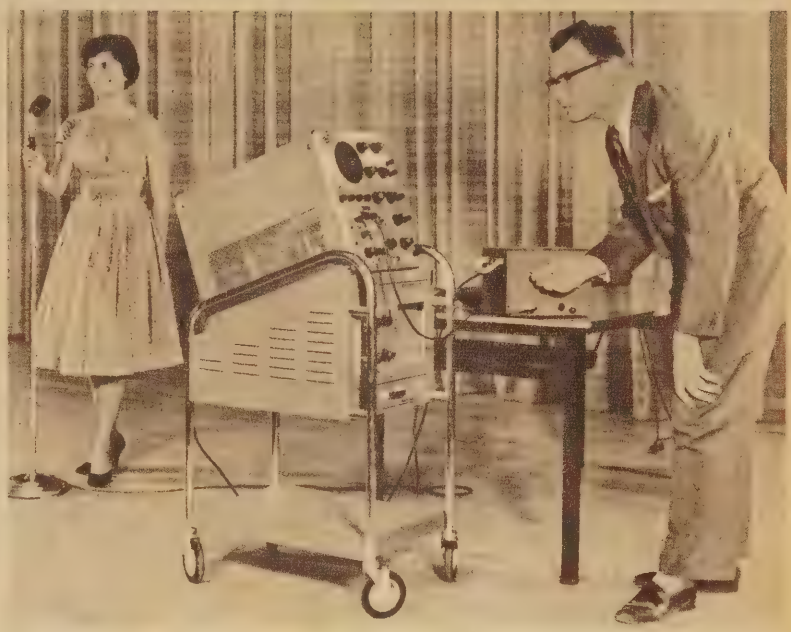
For further information, see Digital recording of electrocardiographic data for analysis by a digital computer, by L. Taback, E. Marden, H. L. Mason, and H. V. Pipberger, Trans. I.R.E. Professional group on medical electronics (Sept., 1959).



Left: Typical heartbeat waveforms, as seen on the oscilloscope.

Left: Analog-digital converter developed for changing heartbeat data to a form suitable for use in a high-speed computer. Mrs H. A. Pipberger, medical technician from Georgetown Hospital, selects a suitable cardiac complex by monitoring signals on oscilloscope, as Dr H. L. Mason of the Bureau looks on.

REDUCES ACOUSTIC FEEDBACK



The frequency shift method of minimising "howling" in P.A. systems is demonstrated by M. R. Schroeder as Terry Andrade speaks into the microphone.

A new electronic method developed by Bell Telephone Laboratories will minimize "howling" in indoor public address systems, and permit volume to be doubled.

THE method copes with "acoustic feedback," the return of room reverberations to the microphone and thus again to the amplifiers. The result of feedback is howl.

The Bell System does not manufacture public address systems, nor does it plan to manufacture the feedback control equipment. The method, however, may be of value to the Bell System in intercom systems and hands-free telephones.

Permitting a twofold increase in the loudness of a conventional p.a. system without introducing howl, the method will also to a large degree offset variations in amplification. The variations could be caused by the heating up of amplifiers, different positions of the speaker or entertainer, and changes in the listening audience.

NEW METHOD

The new method of countering distracting and exaggerated room reverberations is the work of Manfred R. Schroeder, who directs acoustics research at Bell Laboratories. In 1954 he formulated a theory of sound pressure fluctuations inside a room. This theory forms the basis of his invention. Dr Schroeder's discovery resulted from studies in acoustics, the science of sound.

Key to the present development is a device called a "frequency shift modulator." Electronically, it shifts all frequency components of an incoming sound by five cycles per second, an amount that can't be heard for speech and most types of music.

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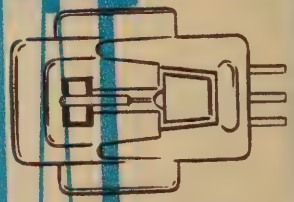

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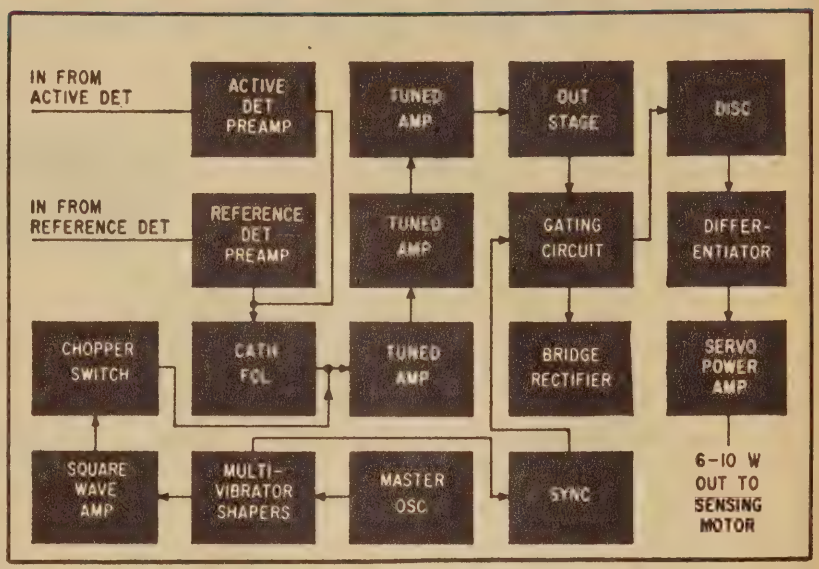
INFRARED SYSTEM CONTROLS AUTOMOBILE BRAKES

A Transistorised "anti-collision" circuit currently under development uses an infrared detector to sense closure between automobiles. Though small, the unit provides 10-w output to operate the brakes.

THE system overcomes many of the serious disadvantages of radar systems by utilising infrared detection methods.

Although infrared has many limitations necessitating a provision for a manual-automatic changeover switch, it has two major advantages. The system, consisting basically of a moderately sensitive infrared receiver with rate circuits, requires no transmitter. A second advantage is the small size, weight, and cost. The 0.09-cu ft device weighs eight pounds.

The whole system is transistorised utilising 21 transistors and nine diodes. Power transistors in the output servo amplifier provide approximately 10w. to operate a hydraulic braking system.



Figue 1: Block diagram of the proposed infrared detection system shows the reference and the active channels.

OPERATING RANGE

In operation, a signal from one or more cars in front is observed at a preset range of from 0 to 1,000 ft by a pair of uncooled indium antimonide detectors. One of them is blacked out and acts as a reference for measuring ambient temperature while the active one looks at the target and detects any difference in temperature from that of the reference cell.

A collimator is mounted directly under the front bumper and, in addition to being adjustable, has spirally cut grooves on the inside in order to minimise reflections. It houses the optical system and infrared filters as well as the active phototube. Directly behind this, in a 1¼ x 1¼ x 1 in box, is a transistorised preamplifier and the reference detector.

The difference signal goes from the preamplifier (Fig. 1) to the main amplifier behind the dashboard and is electronically chopped at a frequency close to 1,000 cps. It then passes through a tuned amplifier (passband about 50 cps) to a gated output circuit which is synchronised with the input at the chopping frequency. This greatly improves the signal-to-noise ratio of the system. A differentiator provides for the closing rate measurements preceded by a demodulator and followed by a servo-power amplifier.

MODULATED SIGNAL

The chopping transistors act as a synchronous-switch type of modulator and the gated output circuit in combination with the synchronous detector is equivalent to a ring-type demodulator. The discriminator circuit is a conventional phase-shift type. The rate signal, which is the most important value measured in this particular system, is obtained from a simple RC differentiator in series with the discriminator.

The servo amplifier output may be used to drive a d-c motor, an a-c motor, an aural or visual alarm or a combination of all of these.

In practice it has been found that this system is only practical for cars almost directly ahead. On these it is extremely good and provides an excellent rate-of-closure signal, which is proportionately applied to the brakes by hydraulic action. In freeway traffic, however, with cars continually cutting in and out at an angle, the automatic system leaves much to be desired; therefore, manual operation under close proximity is recommended. (By W. E. Osborne, 21st Century Electronics, Inc. From "Electronics.")

A NEW ELECTRONIC STETHOSCOPE

The heartbeat of an unborn child can give the doctor much valuable information; for example, whether there is one child or more, whether its heart is normal, how it is likely to react to the shock of birth, and whether complications are likely to arise for child or mother.

THE beat of the unborn—or foetal—heart is difficult to hear with a normal stethoscope, but the soniscope, a new form of electronic stethoscope made in Britain by Faraday Electronics Limited and mentioned recently in a B.B.C. broadcast, will make it possible to obtain a clinical picture of the sound of the foetal heart at great volume without interference from other noises outside or inside the body.

The inventor of the soniscope, Lionel Fothergill, explained in the broadcast how this small instrument—which has a little microphone on a lead and is attached to an ordinary pair of clinical headphones—would enable doctors to detect the strength, rate and rhythm of the unborn baby's heart, and also abnormalities which might make it desirable to remove the baby by operation instead of waiting for normal birth.

It would also greatly reduce the need for pre-natal X-ray examination, now thought to be dangerous by a strong body of opinion.

In maternity wards in hospitals, Mr Fothergill said, the microphone was placed in a special belt which women could wear with comfort even when asleep, and a light indicated the rate and rhythm of the heart, without necessarily tuning in to the sound.

By means of a gadget on her desk the night nurse could check from patient to patient without walking around the ward, and if she wanted to, switch on the sound and listen to the heart. If something seemed to be going wrong, she could push down that switch and take an immediate tape recording which would be helpful to the doctor after he had dealt with the crisis.

The soniscope has many other applications, one of the most important being to listen to the chest and heart of a patient in an iron lung. "It is the only instrument in the world with which you can do that," Mr Fothergill said. "With a normal stethoscope the breath sounds and so on are drowned by the noise of the pumps in the iron lung and, of course, you can't take the patient out of an iron lung because then he can't breathe."

This instrument could be put through the hole in the lung on the patient's chest and tuned in out of sound of the pumps. Only a few weeks earlier, he had had a report from a polio centre in London, where it had been the means of detecting the sudden collapse of the lung of a boy in a plaster cast more than ½in thick and had made it possible to take successful emergency-measures.

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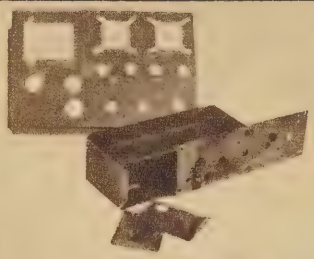
PRICE, complete with 20ft cable £5/5/.



Playmaster control unit boxes, ready drilled complete with front panels and brackets. High quality hammertone finish. Full range of Playmaster amplifier and tuner chassis also available.

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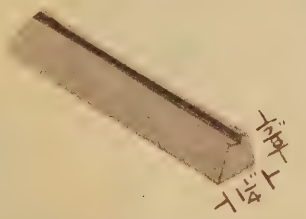
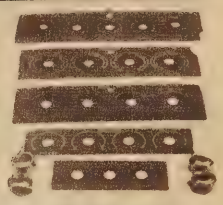
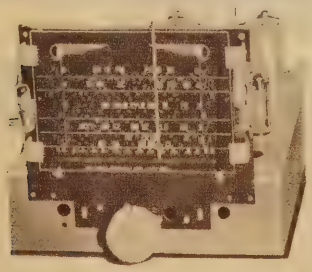


High-grade timber moulding, complete with gold coloured metal insert. Same type as used on highest quality TV cabinets.

Complete kits plus ALL accessories and spares for the "R, TV and H" TV Sets and Playmaster Hi-fi equipment.

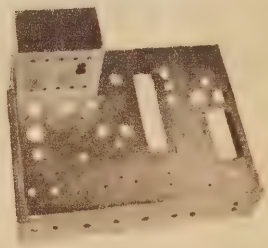


Anodised metal labels to suit various Playmaster amplifiers, control units, and program source. Mono' labels, maroon background with silver lettering. Stereo coffee brown and gold. Beautiful knobs with gold metal centres to match.

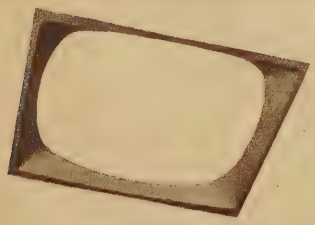


Some very fine hi-fi tuners are included in the Playmaster range. See Playmaster specification sheets for full details.

Timber kits to construct the 110 degree TV cabinet. Everything precision cut. All parts included, glass, mask, beading, gold insert, speaker grille, etc.



TV chassis, specially made for "R.T.V. and H." 110 degree circuit. Cadmium plated, and then passivated to avoid fingermarks. Complete with E.H.T. box, and all holes drilled.



The very best plastic TV masks as used on the finest commercial sets. 21in and 17in. Also available metal reducing mask; hammertone finish to enable 17in set to fit in 21in cabinet.

Q plus Mark V I.F. strip, ready wired and aligned for the 110 degree TV set. If purchased with the Q plus tuner, we will supply them matched.
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Set of 5 high-quality TV knobs for 110 degree TV set. In coffee brown or ivory, with attractive gold coloured, trim station numbers on tuning knob.

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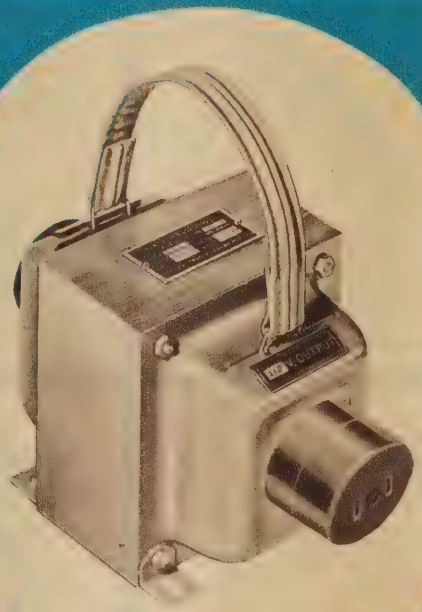

National STEPDOWN TRANSFORMER

110v. APPLICATION GUIDE

Application	Type	Primary Volts	Sec. Volts	Watts	DIMENSIONS H	W	D	MOUNTING CENTRES A	B	OUTLETS No. of
Shavers	SD110/25	240V 50 cycles	110V	25	3¾"	3⅛"	3⅜"	2½"	1⅝"	1
Radios, Mixers, Sewing machines	SD110/60	240V 50 cycles	110V	60	3¾"	3⅛"	3⅞"	2½"	2⅛"	1
	SD110/100	240V 50 cycles	110V	100	3¾"	3⅛"	4½"	2½"	2¾"	1
Small projectors	SD110/175	240V 50 cycles	110V	175	4¾"	4⅛"	4⅝"	3⅜"	2⅜"	1
TV Sets	SD110/250	240V 50 cycles	110V	250	4¾"	4⅛"	5¼"	3⅜"	3"	1
Large projectors and other heavy duty appliances	SD110/400	240V 50 cycles	110V	400	6⅝"	5¼"	5¼"	3⅛"	5⅞"	2
	SD110/500	240V 50 cycles	110V	500	6⅝"	5¼"	5¼"	3⅛"	5⅞"	2
	SD110/750	240V 50 cycles	110V	750	8¼"	6¼"	4¼"	4¼"	4⅞"	2
	SD110/1000	240V 50 cycles	110V	1000	8¼"	6½"	5⅛"	4½"	5¾"	2

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Australasian Engineering Equipment Co. Pty. Ltd., 476 Latrobe St., Melbourne. FY2638.

FACTORY REPRESENTATIVES:

Queensland: K H. Dore & Sons. Brisbane. B0268.
South Australia: B. L. Andrew & Co. Ltd., Adelaide. W1827.
Western Australia: I. W. Holman, Perth. BA8190.

NEWS AND VIEWS OF THE MONTH

Satellite stations

THE first stage of the B.B.C.'s plan for extending and improving the coverage of television and V.H.F. sound services, by building low-power satellite stations in various parts of Britain, has been given approval by the Postmaster-General.

There will be 14 television and 10 V.H.F. stations.

The building program, which will take three years to complete, will increase the B.B.C.'s television coverage from 98.7 per cent to 99.2 per cent of the population and the availability of the three sound services on V.H.F. from 96.4 per cent to 97.6 per cent of the country's total population.

Most of the stations will be "translators," similar in principle to the television translator, developed by the B.B.C., that has been working successfully for a year at Folkestone.

They will be designed to work unattended; each transmitter will pick up signals from an existing B.B.C. station and retransmit them on a different channel.

Television camera

THE B.B.C. Television Service recently began experimental trials of a remotely controlled television camera developed by its engineering division. The camera is located in an interview studio near Broadcasting House in Central London, but all its functions can be controlled from the B.B.C. television news studio at Alexandra Palace about six miles away.

The camera can be switched on from Alexandra Palace and local control is affected by using a set of four push-buttons in a small box at the end of a trailing lead which, in conjunction with changeover controls, allow the camera to be operated by an interviewer to any one of four pre-set shots.

By pressing the appropriate buttons the interviewer can show himself and perhaps two other people in long-shot and then bring any one of the three people into close-up as required.

The "shot-box," as it is called, is small enough to be held comfortably in the hand.

Medical electronics

DETAILS of the third international conference on medical electronics at which more than 2,000 delegates from all over the world are expected to attend were announced in London recently.

Nine foremost subjects ranging from medical electronics in space research to electronic aspects of sight, hearing and locomotion will be covered. The conference will be held in London from July 21-27 and, at the same time, an exhibition will be staged at which firms from all countries can be represented.

Sir Willis Jackson, president of the U.K. Institution of Electrical Engineers, said 100,000 notices were to be distributed overseas and co-ordinators in 36 countries had been appointed. The conference would be on two levels — for specialists and for the general practitioner who wishes to become more informed on specific or general progress.

He issued a strong appeal to all sections with an interest in the subject ranging from industrial firms to hospitals and medical specialists all over the world to come forward either with technical papers or as observers and delegates.

New projector

SPECIAL new projector equipment, designed and built by Philips, has been installed at Sydney's Hoyts Paris Theatre for the screening of the first Super Technirama-70 film to come to Australia, "Solomon and Sheba."

Super Technirama-70, the latest equipment in the motion picture field, is similar to the Todd-AO process, already seen in Sydney in the colourful musical film, "South Pacific."

Super Technirama-70 is projected on 70 mm film on to a huge curved screen. Sound is reproduced through six stereophonic channels.

Because of the high degree of accuracy required, the lenses and focusing arrangements on the projector are made with a precision normally associated with astronomical instruments.

An important feature of the Philips projector is that it can show both 70 mm and 35 mm film, using either the six-track sound system of Super Technirama-70 or Todd-AO, the four-track magnetic system of CinemaScope or the single-track magnetic or optical sound system of conventional 35 mm films.

The changeover from one system to the other can be made in a few moments.

Warm and dry

TWO new British-made fabrics for raincoats are likely to be of wide interest.

One of the fabrics owes its qualities to a process called "Aqua Five," which involves coating fine cotton poplin with plastic.

The advantages of the process are that the fabric does not soak up dirt, grease or oil marks; they remain on the surface and can be wiped off; after dry cleaning the coat needs no re-proofing; and it keeps out the rain.

The laboratories of the Retail Trading Standards Association in England gave Aqua-Five treated material its heaviest test and reported that it had withstood a soaking equal to 3in of rain with no penetration of the fabric.

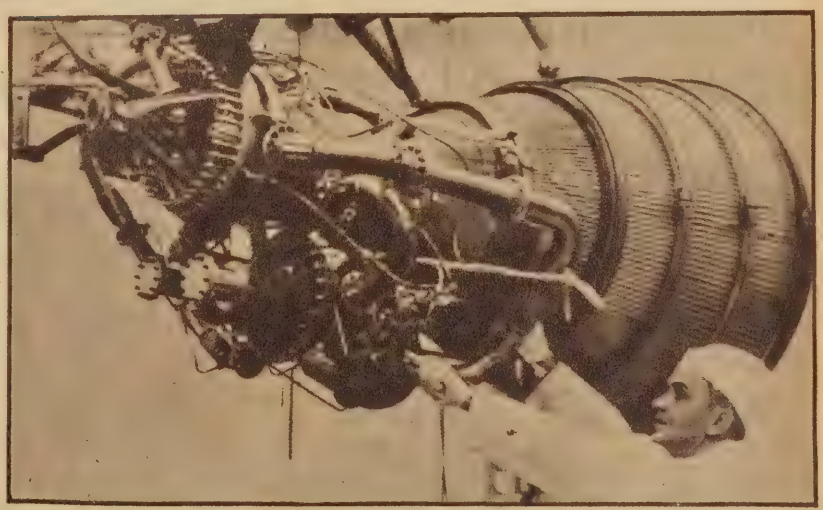
The other new fabric, developed at the Shirley Institute in Manchester and shown to chemists at the recent meeting of the British Association has a skin of aluminium only a quarter of a thousandth of an inch thick.

Mr Howard Rees, of the institute, explained at the meeting that when the aluminium is worn inside, as a lining, it keeps the wearer warm; when worn outside it protects him from the heat. Moreover, the fabric could be made crease-resistant and waterproof.

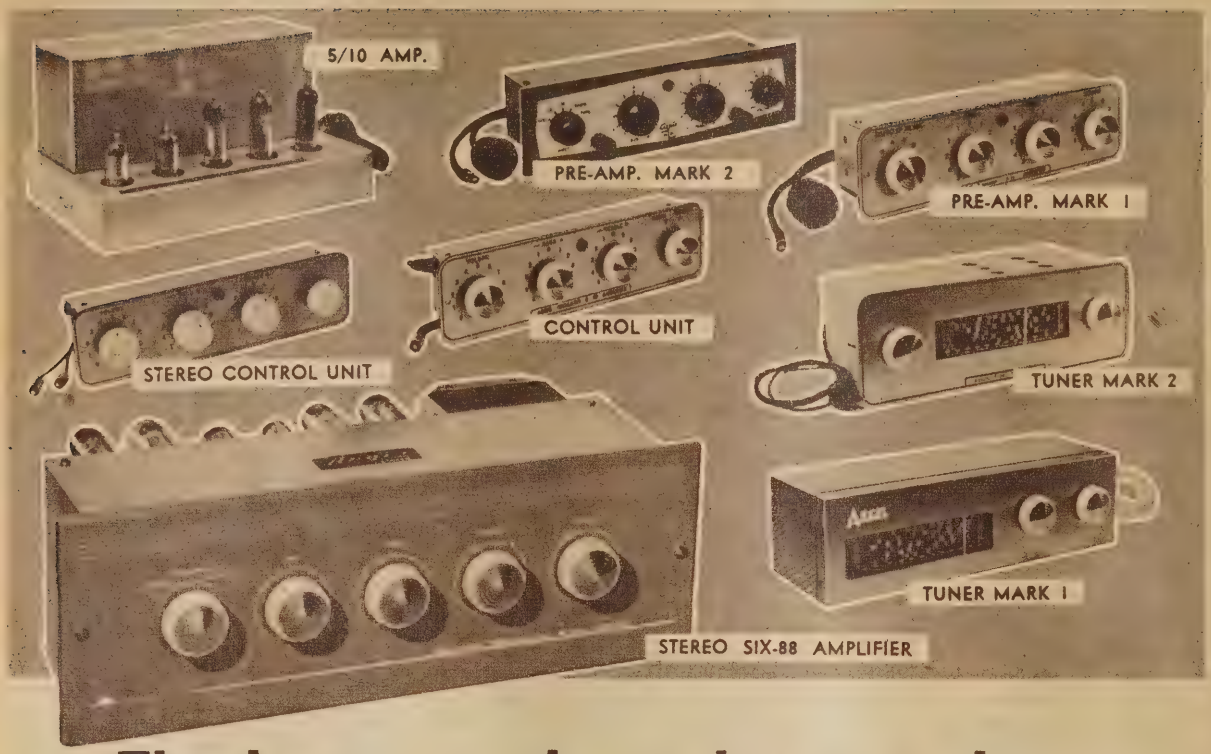
Aluminium foil is impermeable to water vapour, but the real merit of the new invention is that it allows the fabric to breathe, like any other clothing material, so that air can circulate freely round the body.

Among the possibilities Mr Rees mentioned was an aluminised raincoat that would be very light to carry but as warm as an overcoat.

FIRST LIQUID HYDROGEN ENGINE



The first of its type to be developed in the U.S.A., this liquid hydrogen rocket engine is expected to open new fields of achievement for missiles and space vehicles. Designated as XLR115, the engine is undergoing development by the Pratt and Whitney Company, at their Research and Development Centre in Florida.



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AMPLIFIER CONTROL UNIT

12in x 3in x 1¾in recommended for crystal pick-up and tuners only. Input selector switch for tuner and pickup, bass and treble boost and cut controls and volume control (without A.C. mains switch). **£7/17/6.**

STEREOPHONIC CONTROL UNIT

Compact in every way, this unit is recommended for correct stereophonic coupling of two Aegis 5/10 Ultra Linear Amplifiers, **£17/15/.**

INTEGRATED STEREO SIX-88 AMP.

Choice of three inputs (1) Stereo, (2) Monaural, (3) Radio Tuner. For crystal pickups only. Power output rating: 8 watts r.m.s. maximum. Valves: 2 x 12AX7 and 4 x 6BM8 plus two silicon diodes type OA210. Each of the six are double valves. **£69/17/6.**

PRE-AMPLIFIER Mark 1

12in x 3in x 1¾in. Inputs for radio and microphone; treble and bass controls, selector switch and A.C. mains, switch on volume. 1 valve: type EF86 **£21/17/6.**

PRE-AMPLIFIER Mark 2

Fits same cut-out as the Mark 1. Inputs for tape, microphone, radio tuner, pickup; with pre-set input control. Tape-RE-cord and playback jacks on front panel, input selector switch, bass, treble and volume controls with mains switch. 2 x type EF86 valves. **£26/15/6.**

FIDELITY RADIO TUNER Mark 1

Incorporates its OWN POWER SUPPLY. I.F. stage has band width nearly double that of ordinary receivers. Latest circuit techniques and miniaturisation of components. **£35.**

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Power supply drawn from existing power amplifier. Performance ratings identical to Mark 1 Tuner. **£32/17/6.**

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Barriers catch planes

AIRCRAFT crash barriers are being installed at R.A.A.F. flying bases at Butterworth, Malaya; Amberley, Qld.; Williamtown and Richmond, N.S.W.; Sale and Laverton, Vic.; and Pearce, W.A.

Mr F. M. Osborne, Minister for Air, said that the barriers would "catch" aircraft in the event of one failing to take off or making an emergency landing without brakes.

The arrester barriers are made of nylon ropes connected to steel wire ropes and pneumatic braking units.

Developed for the Royal Swedish Air Force, the arrester barriers are designed to arrest "runaway" aircraft without injury to the crew and with minimum damage to the aircraft.

The barrier will be lowered when not in use but can be raised in an emergency in only 10 seconds.

TV traffic control

CLOSED circuit television, which enables one policeman to control four busy traffic lanes at West Drayton, Middlesex, went into operation recently.

The television system has been specially designed by E.M.I. Electronics Ltd. to operate under all weather conditions and will be used to assist the police in traffic control while road widening work is in progress.

Without the aid of television three policemen would have been required to regulate traffic. The point duty policeman is able to watch traffic conditions on two roads, which he would not otherwise be able to see, on a monitor screen set up in a special police box.

The television camera has been mounted on a lamp standard 20ft above the ground.

Even under difficult lighting conditions the highly sensitive camera is able to relay good quality pictures to the police box.

Really round!

MOST people think of precision engineering in linear terms. But very exact standards are also required for roundness, or, in engineering terminology, circularity. A Colchester firm is producing lathes which cut circles of metal with a degree of accuracy new to the industrial world. In the B.B.C. program, "Science and Industry," Will Summers has described a visit to the firm.

He found lathes coming off the assembly line at the rate of one every 35 minutes. The firm knew what standards they had to surpass, since any lathe manufacturer selling his product always supplies with it a chart illustrating its accuracy.

This company sends out two charts—one of the generally accepted standard, and a second one showing by how much that accuracy has been improved on.

Special instruments were used to check the roundness of a piece of metal that had just been cut. The resulting graph showed that the circle was 2/10,000in out of true.

This, about a hundredth part of the thickness of a human hair, is normal. But the firm declined to sell the lathe until it had been made twice as accurate —that is, to within 1/10,000in of perfection.

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TELEVISION CALIBRATOR TYPE A56057

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RF Output: More than 100 mV.
Provision for vertical and horizontal bars

VOLTOHMYST TYPE A56010

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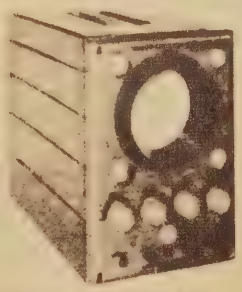
AC. volts: 0 to 1500V.
Resistance: 0 to 1000M ohms.
DC. current: O to 1500 mA.
Accessories available for 30 kV and 250 Mc.

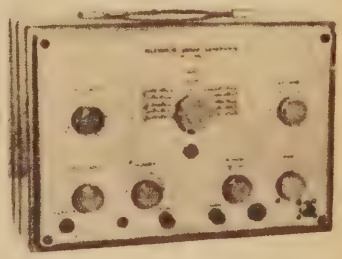


SWEEP GENERATOR TYPE A56036

RF frequency range: TV channels 1 to 10.
IF frequency range: 500 Kc to 50 Mc.
Sweep width: 0 to 10 Mc.
Provision for Oscillograph time-base and phasing control.

OSCILLOGRAPH TYPE A56031

Frequency range: DC to 1 Mc.
Time-base: 3 cycles to 30 Kc.
Sensitivity: 10 mV RMS/inch.



Brisbane and Northern Rivers readers, for further literature write to

CHANDLERS

Cnr. Albert & Charlotte Streets, BRISBANE 31 0341

Given an old but serviceable vibrator and transformer, there is an excellent chance of making them work your electric razor in surroundings like this.

You Don't Have To Shave Like This!

Here is an idea which will be of interest to the many men who normally use electric shavers, but who have to revert to more brutal methods when on holidays, or in other situations where the mains power is not available.

By John Barker

AT this time of the year in particular, there will be thousands of people in pursuit of holiday joys, variously camping, boating, hunting, living in weekenders or perhaps just driving around. Everyone is having a whale of a time, except the males of the party, who have to go through the daily grind of removing the stubble, which always seems to thrive particularly well at times like this.

BATTERY POWER

In many instances, when the mains power is not accessible, there will be a 6 or 12 volt battery in use; in the car, in the boat or even part of a lighting plant, so that what is needed is a light, compact, fairly inexpensive converter to change 6 volts DC into 250 volts, AC or DC, depending on the particular shaver, which the good man owns.

The unit to be described does just this. It will supply up to 15 watts to suit the larger shavers and can be built into a small plastic case similar to the one photographed, or may be mounted permanently in the car for year-round use.

Because there are both AC only, and AC/DC shavers on the market, we have considered it necessary to describe two versions; one, the AC unit, produces 250 volts at 50 cps and the other, the DC unit, produces 250 volts DC.

In general, shavers with brush type motors will be AC/DC and those with induction motors and the vibrator type will be AC only. However, they are usually marked.

There is one brand of shaver which features two windings; one 250 volts and the other 6 volts which are selected at will. This is most convenient but they are fairly new and by far the greater number of shavers in use will be 250 volts only.

The DC converter is quite straightforward and uses a conventional synchronous vibrator, as will be seen from the circuit. It is the simplest to construct.

The AC version uses a non-rectifying vibrator and the AC is taken from the secondary of the transformer. The 50 cps is produced by suitably "doctoring" the vibrator cartridge in a manner to be described.

Since the same actual transformer may be used in either the AC or the DC circuit, the following remarks apply equally well to both cases.

WORTH A TRIAL

A wide choice is possible in respect to this component. A vibrator transformer has the necessary tapped primary but a mains power transformer with two filament windings is often just as good. Even a power transformer with one 6.3 volt winding and a 5 volt rectifier winding will work. The slight unbalance introduced can generally be ignored in this very uncritical application.

The main thing is to connect up any transformer you may have on hand and try it. If it gives from 200 to 250 volts AC or DC (depending on the version you choose), with the right buffer capacitor, it will do. You will be able to shave electrically, after all.

A point to watch, when using a power transformer, is that the two primary windings must be connected to give an aiding flux. The correct connection will give the greatest output and is best found experimentally. Try it one way then reverse the connections to one of the windings and try again.

One transformer in the units pictured is a regular vibrator type rated at 250 volts a side, 60 ma, with a 6 volts per side primary. This gives 250 volts DC when connected to a 15 watt AC/DC shaver and 250 volts AC, with the appropriate circuit changes, when connected to the same shaver.

While this transformer is therefore eminently suitable, we would not specify it as a "must".

Due to the increase in the use of transistorised equipment in recent years, many dealers have surplus vibrator transformers on hand. Some of these stocks are becoming available at reduced prices and transformers suitable for our converter may well be included. It would be worth some enquiry.

We noticed, for instance, that Ferris Bros. Pty. Ltd., were advertising surplus stock in last month's issue. A telephone enquiry revealed that one particular transformer, type 107, was perfectly suit-

able for the AC unit and is available for 17/6. It does not have a centre-tapped secondary, unfortunately, so cannot be used in a synchronous circuit.

Other transformers available will be suitable from an electrical point of view but are physically too big for the plastic case we had in mind. There are, however, several standard vibrator transformers available through normal channels which do fit and do have the necessary centre-tap for DC connections, where these are required.

The vibrator type again is not critical and an ordinary synchronous cartridge may be used in either circuit. In the AC version we wired the two sets of contacts in parallel, as shown in the circuit. This also helps distribute the current being broken by the primary contacts.

BUFFER CAPACITOR

Different transformers will require different values of buffer capacitor. Their purpose is to "tune" the transformer so that a minimum of sparking occurs at the points. In the absence of a C.R.O. to study the waveform, it is sufficient to try different values and select finally the pair which gives minimum primary DC current with no load on the secondary.

If is good practice to use as large a value of capacity as possible, consistent with minimum primary current. In our case, for the DC unit, the best value was 0.047 mfd.

Also, because of the nature of the vibrator action, there is present in the wave-forms some very high voltage peaks produced by the inductive "kick" of the transformer when the points open. Therefore it is necessary to use a high voltage capacitor for the buffer. 600 volts working should be adequate for this service.

The 1 mfd capacitor across the 250 volt output helps smooth and maintain the DC at a high level. It is a 600 volt paper so that there is no worry about polarity. An electrolytic could be used if you so desire, preferably with a rating of 600 volts DC working. With an electrolytic, you will have to watch the polarity, however.

The AC version is just a little more complicated. The normal vibrator operates at a frequency close to 120 cps, which is too high for most shavers, but, if its reed can be tuned to within 10 cycles of 50 cps, it will suit the purpose.

PERFORMS WELL

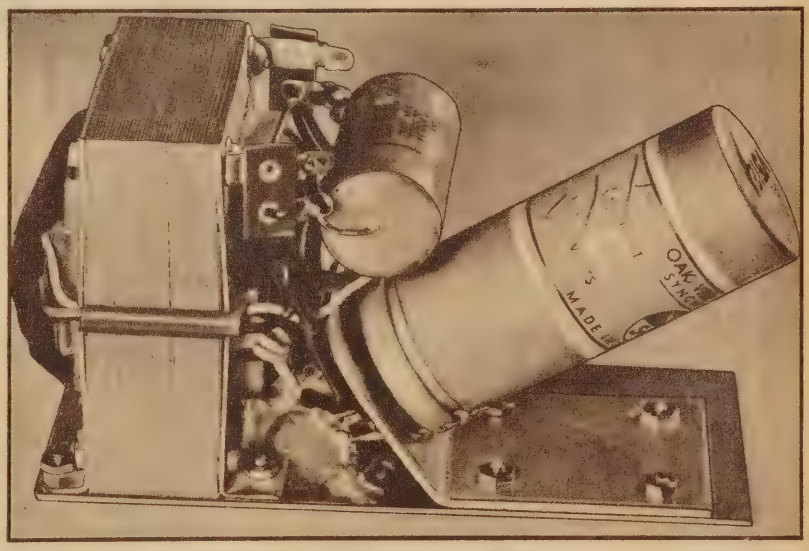
An identical converter, built several years ago by the writer and using a similarly tuned vibrator, has been in continuous use ever since, without one failure. It has had a thorough and arduous testing and has been generally most satisfactory.

Some general inquiries have revealed that 50-cycle vibrators are not readily obtainable, except for quite heavy duty applications and they are expensive. In any case, since this is a very light duty application, considered over a period, it is possible to use almost any cartridge,

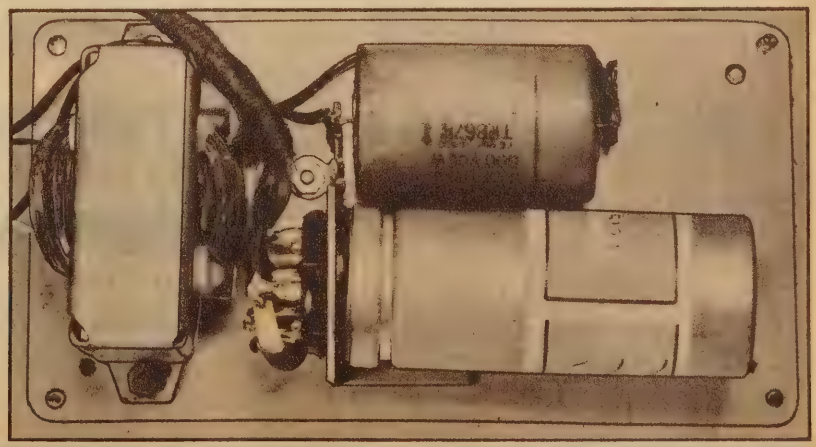
Compact transformers will allow the components to mount flat on the baseplate, as in this picture. Fortunately, layout isn't critical. Rating of this transformer is 150 volts per side at 40 mA.

TYPICAL SUPPLY CONSTRUCTION

If concerned by compactness and appearance, your supply can be built up in a plastic box like this, measuring 3½ x 2¾ x 6⅜ ins. overall. The boxes are available through radio trade houses.



With larger style transformers, the supply may have to lie on its side in the box, with the vibrator angled up into one corner. Note the buffer capacitor mounted on tagstrips under the transformer bolts.



17 INCH 70 DEGREES
17 INCH 90 DEGREES
17 INCH 110 DEGREES
21 INCH 70 DEGREES
21 INCH 90 DEGREES
21 INCH 110 DEGREES
24 INCH 90 DEGREES
24 INCH 110 DEGREES
14 INCH 110 DEGREES
14 INCH 90 DEGREES
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TE7/FP

even one rejected for lowered efficiency in some more exacting service.

Tuning the reed to 50 cps is not particularly difficult but it does require some patience. It involves adding solder to the top of the reed under the magnet to lower its resonant frequency, together with some method of judging this frequency as the solder is added.

The best method of frequency measurement is to compare the unknown, from the secondary of the transformer, with say the 50 c/s from the mains with the aid of a cathode ray oscilloscope. The unknown is applied to one set of plates and the known to the other set and when the two are equal a circle or elipse appears. Users of CROs will be familiar with the technique.

Another and more elementary method is to place a 50 cycle stroboscope on a gramophone turntable and illuminate it with a 15-watt globe, the latter temporarily operated from the converter. When the frequency is right, the radial lines appear stationary. It is necessary that the stroboscope pattern be shielded from room lights to avoid confusion.

ELECTRIC CLOCK

Yet another way is to plug in an electric clock and check its accuracy over periods of from five minutes to 10 minutes. This is certainly a lengthy business but is quite accurate. The clock's speed will be directly proportional to the frequency.

Since the reed is made of springy steel with a soft iron tip or armature it will have to be taken out and tinned. To do this remove the two bolts at the base of the frame, remove the whole armature and contact assembly and slip the bolts back through the holes in the assembly to keep it all together. You will then have the frame with its magnet separate from the armature, contacts and base. This is shown in the phtographs.

Now thoroughly clean the whole surface of the soft-iron tip and the portion of the reed immediately behind it. This is best done by scraping it with a razor blade. (The one you are using because you can't plug in your shaver will do). A very slight smear of soldering paste is then applied and the solder should flow on fairly easily.

From this point on, stick solder is best, since the resin in cored solder tends to run down the reed and in amongst the contacts.

ADDING SOLDER

The level of the solder is gradually built up by adding drops progressively around the tip. It may be a good idea to practice on another similarly shaped piece of scrap metal first. The final size should be approximately ¼ins wide, and about 5/16ins thick. The soft-iron tip will then be completely surrounded by a cylindrical lump of solder.

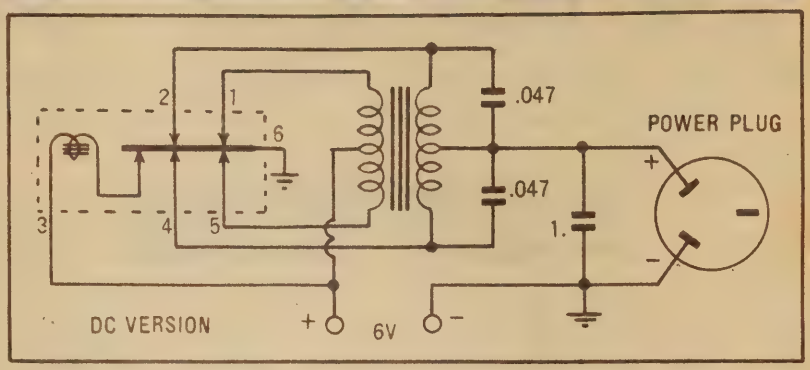
When the vibrator is re-assembled the soft-iron armature will still need to oscillate quite close to the magnet so as not to impede the normal vibrator action. Therefore it will be necessary to file a flat on top of the added solder so it will not touch the magnet. This is best adjusted by trial and error.

Now re-assemble the vibrator. Just before the two holding bolts are completely tightened adjust the leaves so that the faces of the contacts are square and parallel. Tighten the bolts and adjust the reed contact screw so that the gaps between the contacts are equal and make sure that the soldered tip just clears the magnet. Now you are ready to try it out.

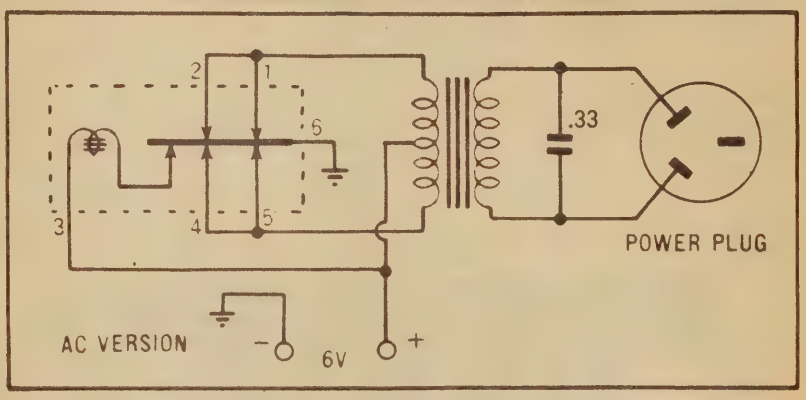
Temporarily wire the circuit shown in breadboard fashion using about 0.5 mfd 400-volt for the buffer capacitator C and attach a C.R.O. or an A.C. voltmeter across the secondary. Connect a D.C. meter in one of the battery leads to measure the primary current, switch on and adjust the reed contact screw for

(Continued on Page 39)

CIRCUITS FOR AC, DC VERSIONS



This is the DC version. The pin numbers refer to the base of vibrator type V5124 which is one we had on hand. Other vibrators may have similar base connections but it will be wise to check.



The AC version with a synchronous vibrator. The unused set of contacts are wired in parallel with the primary contacts. A non-synchronous vibrator is just as good.

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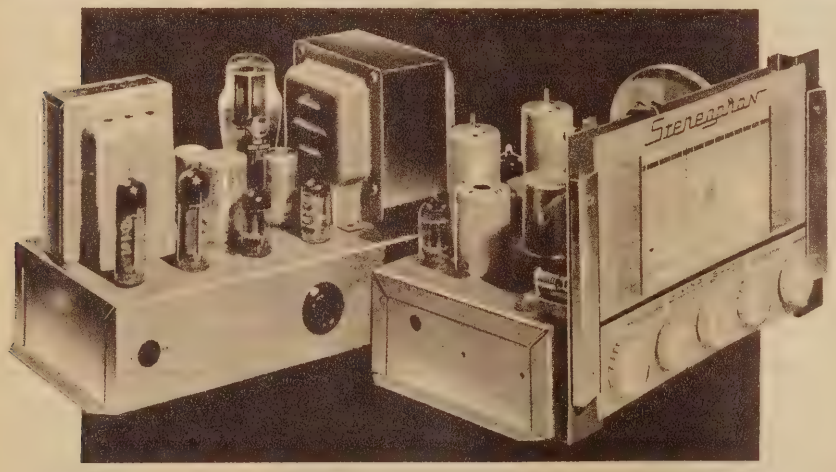

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SPECIFICATIONS ON OPPOSITE PAGE

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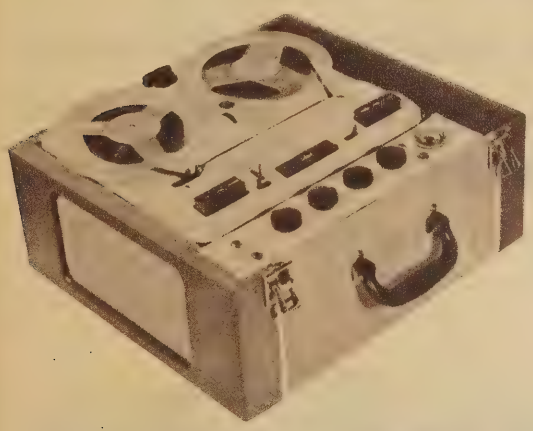

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No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical.
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- **THREE SPEEDS**
3¾, 7½ and 15 inches per second.
- **FOUR HEADS**
Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 to 1.0 per cent.
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Dual speaker combination using the new Jensen M.S.P. 12PR woofer with matched tweeter and cross-over network giving a frequency response of 40 to 12,000 cycles. If required the Rola 12MX speakers can be supplied (with the 8 valve stereo chassis, two Rola 8MX speakers are supplied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

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NEW:

Sensitive 'magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

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the most stable operation of the vibrator. At this position the secondary output will be a maximum.

Now, as in the DC circuit, the value of the buffer capacitor will need to be varied for minimum primary current. This turned out to be 0.33 mfd with our transformer. Similarly, a 600-volt paper is required.

The frequency may now be checked by one of the methods mentioned above. If the frequency is still too high add a few drops of solder to either side, if too low, which is very unlikely in most cases, remove some. It may be necessary to check the position of the reed contact screw during these adjustments and possibly the buffer capacitor.

Before connecting the shaver, try a resistor of about 5,000 ohms and measure the voltage across it. If about right, plug in the shaver or a 15-watt globe if you wish to use the stroboscope. If a clock is used to measure the frequency connect about 6,000 or 7,000 ohms in parallel with it, since the average electric clock draws only about two watts.

ROUGH GUIDE

Because the waveshape at the secondary is more like a square wave than a sine wave, the actual reading of the A.C. voltmeter will not mean a great deal, since it will be calibrated for a pure sine wave. Only the C.R.O. will indicate the true voltage present. However, the reading on the voltmeter can be taken as a rough guide, in the absence of a C.R.O. and will indicate whether or not the voltage lies in the two hundreds which will be suitable for the shaver.

If the output voltage under load is too high, a series resistor will be required.

There is no need to worry about over-loading the transformer, because the time required for an average shave is very small when compared with the rest periods. There will be some heating effect if a vibrator transformer is used which is normally operated at 120 c/s and the same applies to the vibrator magnet coil but again, because of the small time involved, it is negligible.

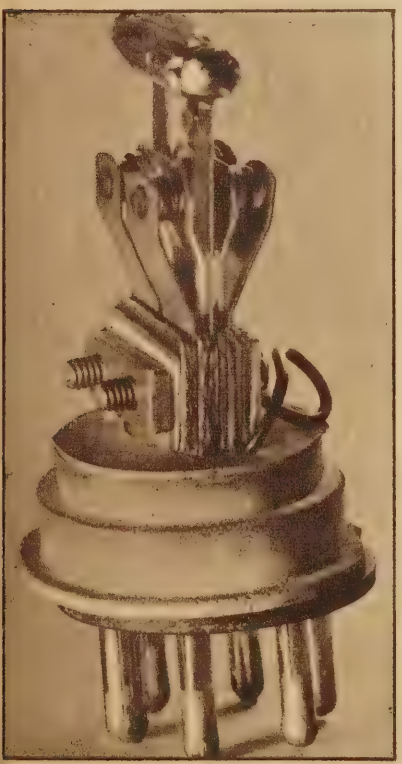
We operated a small 10-watt fan from our unit for the whole of one afternoon without any disastrous result, but we do not recommend this as a normal procedure.

For portable use a case of some sort is indicated. If your transformer is small enough, the plastic box into which we fitted our components could be used. It measures 3¼in x 6 3/8in x 2¼in deep, and is available, through your local supplier, from the agents Watkin Wynne Pty. Ltd., Crow's Nest, Sydney.

We mounted the components as shown on a piece of aluminium, 5 7/16in x 2¼in, which fits into one side of the box. Thus the transformer is lying on its side. The vibrator is mounted at an angle on a small bracket. The capacitor, or capacitors, are fitted in as best as possible so as to clear the sides of the box.

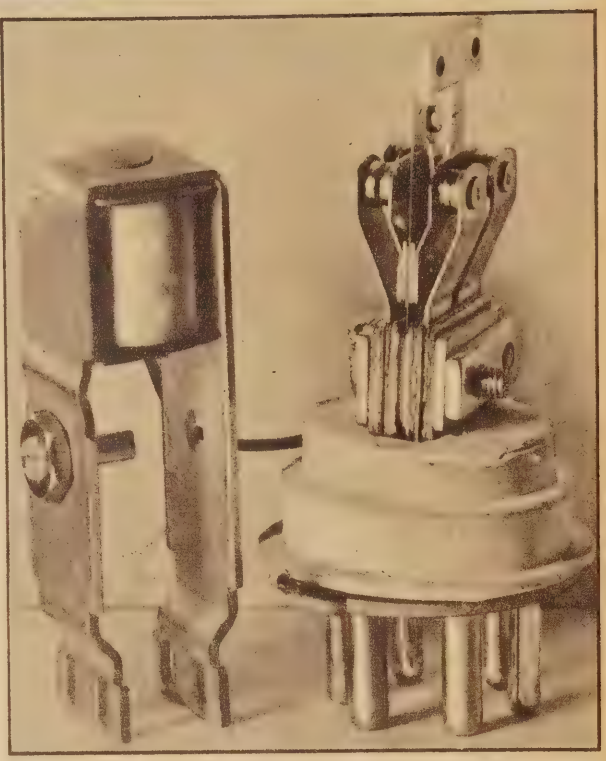
A white power socket was screwed to one end and a hole drilled in the other for the battery cable. A base plate, 6¼in x 3 3/8in, fits into the bottom of the box and is held in place by four bolts which screw into the corner mouldings.

Some red leatherette was glued to the outside of the base plate, which also has four rubber feet to absorb some of the vibration, and the whole effect is quite good. We are even considering fixing a steel mirror to the leatherette between the feet for complete convenience.



The reed after the solder has been added. Be careful to remove any particles of solder and resin (if cored solder is used) which may cause trouble later on.

VIBRATOR MODIFIED FOR 50CPS



Here is the vibrator with the magnet and frame temporarily removed. There are two plastic tubes, through which the bolts slip, which are used to centre the reed and contacts, so the vibrator is fairly easy to re-assemble accurately.

☆

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PF185	240	150-0-150	30	6.3V-2A
PF299	240	285-0-285	40	6.3V-2A, 6.3V-tapped 5V-2A
PF300	240	325-0-325	40	6.3V-2A, 5V-2A
PF201	240	225-0-225	50	6.3V-2A
PF1459	230, 240, 250	250-0-250	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF151	230, 240	285-0-285	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF1388	230, 240	300-0-300	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF166	230, 240	325-0-325	60	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF165	230, 240	385-0-385	60	6.3V-2AC.T., 5V-2A
PF1460	230, 240, 250	250-0-250	80	6.3V-2AC.T., 6.3V-tapped 5V-2A
PF1428	230, 240, 250	250-0-250	80	6.3V-2AC.T., 6.3V-0.6A
PF170	230, 240	285-0-285	80	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF1073	230, 240	300-0-300	80	6.3V-2AC.T., 6.3V-1A
PF169	230, 240	325-0-325	80	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF168	230, 240	385-0-385	80	6.3V-2AC.T., 6.3V-2A, 5V-2A
PF1509	200, 230, 240	140 *	100	6.3V-2AC.T., 6.3V-2A
PF130	230, 240	285-0-285	100	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF164	230, 240	325-0-325	100	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF160	230, 240	385-0-385	100	6.3V-2.5AC.T., 6.3V-2A, 5V-2A
PF1072	230, 240	300-0-300	120	6.3V-4AC.T., 6.3V-tapped 5V-2A
PF152	230, 240	285-0-285	125	6.3V-3AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF163	230, 240	325-0-325	125	6.3V-2.5AC.T., 6.3V-2A, 6.3V-tapped 5V-2A
PF181	230, 240	385-0-385	125	6.3V-3AC.T., 6.3V-3A, 5V-2A
PF1508	230, 240, 250	250-0-250	150	6.3V-4AC.T., 6.3V-tapped 5V-2A
PF174	230, 240	285-0-285	150	6.3V-3AC.T., 6.3V-3A, 6.3V-tapped 5V-3A
PF142	230, 240	325-0-325	150	6.3V-2AC.T., 6.3V-2A, 6.3V-tapped 5V-3A
PF175	230, 240	385-0-385	150	6.3V-2AC.T., 6.3V-2A, 5V-3A
PF173	230, 240	425-0-425	175	6.3V-3AC.T., 6.3V-2A, 5V-3A
PF1335	230, 240	305-0-305	180	6.3V-4AC.T., 6.3V-4A, 5V-3A
PF1067	230, 240	400-0-400	180	6.3V-2.5AC.T., 6.3V-4AC.T., 5V-3A
PF1412	230, 240	300-0-300	200	6.3V-3.5AC.T., 6.3V-3A, 5V-3A
PF172	200, 230, 240	500-0-500	200	6.3V-4AC.T., 6.3V-3A, 5V-3A
PF814	200, 230, 240	1000-0-1000	200	5.5V-0.3A
		or		
		750-0-750	250	
		or		
		500-0-500	300	
PF179	200, 230, 240	475-0-475	225	6.3V-4AC.T., 6.3V-2A, 5V-3A
PF171	200, 230, 240	385-0-385	250	6.3V-4AC.T., 6.3V-3A, 5V-3A
PF107	230, 240	585-0-585	250	6.3V-3A, 6.3V-3A, 5V-3A
PF1193	200, 220, 240	295-0-295	275	6.3V-9A, 6.3V-tapped 5V-3A
PF1193V	200, 220, 240	295-0-295	275	6.3V-9A, 6.3V-tapped 5V-3A
PF1448	230, 240, 250	115*	300	12.6V C.T.-5A

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FROM THE SERVICEMAN WHO TELLS

The suitability of foreign TV sets for use in Australia is under discussion again this month, prompted by a letter from an overseas reader. Closer to home, I have a strange story about a tape recorder and why it wouldn't erase.

THE correspondent who raised the question of foreign TV sets again is Mr G.S. from no less a place than Voorschoten, Holland. (The old magazine certainly gets around!)

Mr G.S. takes me to task—in a very pleasant way, I hasten to add—concerning my article in the October issue last year, in which I discussed the problems of converting English and American TV sets to operate on Australian standards.

Mr G.S. has no quarrel with what I said but, rather, with what I didn't say. He points out that I made no mention of the various European countries which use standards almost identical with our own and that, since we get a percentage of our migrant population from these countries, a resume of these systems is necessary to complete the picture.

Touche, G.S.! (or whatever is the Dutch equivalent).

NOT OVERLOOKED

To be quite honest, I had not completely overlooked these systems, but I was more interested in discussing those which were grossly incompatible from a practical point of view. After all, the migrant who brings in a readily compatible set — even in ignorance — runs very little risk. It was the risk of serious financial loss associated with the incompatible types which prompted me to sound the warning I did.

However, I agree that there is some point in considering what can be done as well as what cannot. And to make this easier, Mr G.S. has gone to a good deal of trouble to list the various systems and channels in a very convenient form, and I am reproducing them here much as he prepared them.

Summarising these data, it would appear that sets made for any of the European CCIR systems would be suitable for Australian conditions as far as the standards are concerned, being virtually identical.

RUSSIAN STANDARDS

Russian sets would appear to differ only in the sound and vision difference frequency, probably putting them about on a par with the American sets in that respect.

The northern Belgium system looks promising at first, but the use of positive modulation and AM sound would make the problem almost as serious as for the British receivers. Along with the southern Belgium system, which resembles — but still differs from — the French system, it would have to be regarded as incompatible.

However, apart from standards, we still must consider the channels involved. Where these are identical there is no problem but, where they differ by a few Mc it is necessary to consider some of the points I made about the American channels in the October article.

Let us first consider the European CCIR channels. Our channel 1 (49-56 Mc) is close to their channel 2 (47-54), our channel 2 (63-70) is close to their channel 4 (61-68), but there is no equivalent of our channels 3, 4 and 5.

Our channels 6, 7, 8, 9 and 10 are exactly the same as their channels 5, 6, 7, 8 and 10 respectively, meaning that there is no problem here apart from the wrong number on the channel selector knob.

However, the absence of channels 3, 4 and 5 could be serious. These channels, although not in use at present are tentatively allocated in the broad plan. Channel 3 is intended for country areas and 4 and 5 are to be made available some time after the middle of 1963. Channel 4 is one of those allocated to Hobart in Tasmania, among other places.

Thus it may depend exactly on where a migrant intends to settle as to whether his European set would suit him. Of course, it may not be difficult to have new "biscuits" (coil assemblies) fitted to his tuner to cover these freqcencies, and the original manufacturer would be the best person to advise on this point. Fairly obviously he should try to have this done while in his own country.

RUSSIAN CHANNELS

Incidentally, while checking on some of these figures I had a look at the Russian channels. It is not likely that we will get many migrants from there, or that they will bring their TV sets with them, so I won't go into lengthy details, but the position would not be particularly bright. There is no equivalent of channel 2, the nearest to channel 7 is 3 Mc away and to channel 9, 4 Mc away—one on either side.

I also checked on the Japanese system, since many travellers from Australia may be intrigued by the prices of these sets. Apart from the channels, this seems to be an exact copy of the American system, so that most of what I have already said would apply to these. However, the channels would appear to be less favourable.

There is no equivalent of our channels 1, 2, 3, 4 or 5, the system commencing at 91 Mc, with their channel 1 being closest to our channel 3 but still 6 Mc higher. Their channel 4 is within usable distance of our channel 6, as is their channel 6 and our 7. Our channel 8 would present a problem, being 5 Mcs from their channel 6 and there is no equivalent of our channels 9 and 10.

And, just to forestall any irate importers who may be seeking my blood, I would hasten to add that these comments apply to sets designed for use in the countries concerned; not those made in those countries and possibly designed for export to Australia. That is a completely different situation.

MAJOR SYSTEMS

And that, along with the October discussion, should just about sum up the main TV systems throughout the world. (I probably will receive an indignant letter by return post from an Argentinian reader complaining that I have overlooked their system. Well, at least, I know it uses 625 lines.)

My case history this month is the rather strange story of a tape recorder. The owner brought it to me with the complaint that it was failing to erase correctly. He emphasised the point by stating that he could use a tape only three or four times before it had to be discarded due to the high background noise and general "gabble" left over from previous recordings.

It was an American model, of very well-known make, though not seen very frequently in this country. However, I knew enough about it to know that the complaint was not inherent in the design. On the contrary, I would have expected a first-class performance from such a machine.

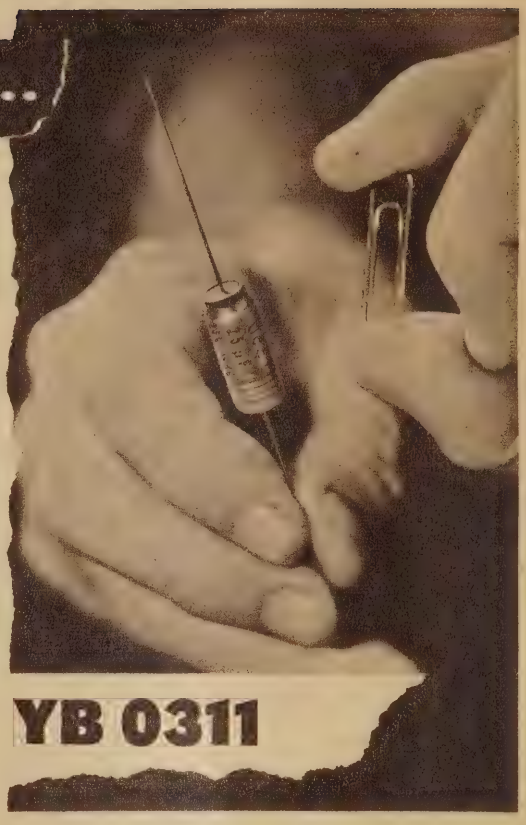
Partly to make conversation, and partly because I always like to know as much about the history of such devices as possible, I asked the owner how he had acquired it. I rather expected he had purchased it in the U.S. during a recent overseas tour.

He confirmed that he had purchased it while overseas, but not in the U.S.

EUROPEAN (CCIR) CHANNEL ALLOCATIONS

Channel	Lower Limit	Vision	Sound	Upper Limit
1 (6 Mc only)	41	42.25	46.75	47
2	47	48.25	53.75	54
3	54	55.25	60.75	61
4	61	62.25	67.75	68
5	174	175.25	180.75	181
6	181	182.25	187.75	188
7	188	189.25	194.75	195
8	195	196.25	201.75	202
9	202	203.25	208.75	209
10	209	210.25	215.75	216
11	216	217.25	222.75	223

TRY THIS FOR SIZE...



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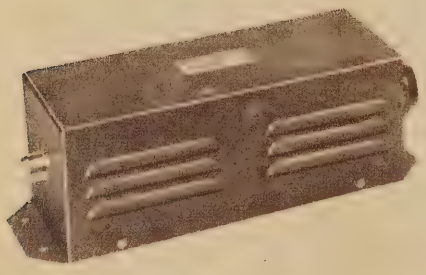

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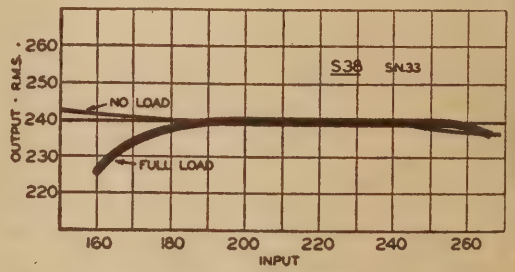

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A SUMMARY OF WORLD TELEVISION STANDARDS

Characteristic	Europe CCIR	Belgium North	Russia	Belgium South	France	Britain	U.S.A. Japan
No. of lines	625	625	625	819	819	405	525
Channel width Mc ..	7	7	8	7	13.5	5	6
Vid. bandwidth Mc ..	5	5	6	5	10.6	3	4
Pic./sound diff. Mc	5.5	5.5	6.5	-5.5	11.15	-3.5	4.5
Horizontal freq. ..	15625	15625	15625	20475	20475	10125	15750
Field freq.	50	50	50	50	50	50	60
Picture freq.	25	25	25	25	25	25	30
Aspect ratio	4/3	4/3	4/3	4/3	4.12/3	4/3	4/3
Picture modulation ..	Neg.	Pos.	Neg.	Neg.	Pos.	Pos.	Neg.
Sound modulation ..	FM	AM	FM	AM	AM	AM	FM
Black level %	75	25	75	25	25	30	75
White level %	10	100	10	100	100	100	15
Aerial polarisation ..	H	H	H	H	H & V	H & V	H

"Europe" includes Holland, Germany, Scandinavia, Italy and Switzerland. Australian standards are virtually identical with CCIR. Note re "Sound/difference frequency." Negative sign indicates sound carrier lower than picture carrier.

It seemed that he had acquired it at a very attractive price while travelling in China. Since it was supposedly brand new, with all the indications that this claim was true, it seemed too good an opportunity to miss. However, it had suffered from the poor erase problem right from the start.

And, on that note, the unit was passed across the counter into my care, along with a 240/110 step down transformer to go with it, which the owner explained he had purchased along with the machine to adapt it to Australian power mains.

NO DATA

I had no circuit or other details of the device and I felt that I could use this information. What was more, the owner was a regular customer, and it looked as though I might have to service this recorder for some years to come. In the circumstances, I promptly despatched a letter to the makers requesting as much data as possible. In the meantime. I tackled the job, anyway, in the hope that it would turn out to be something obvious.

I played one of the tapes he had left with me and it certainly contained a babble of sound from previous recordings. I was able to make another recording over this quite satisfactorily, but the babble remained as a quite objectionable background. I tried erasing my own recording, but found that it remained as a weak addition to the babble.

Next I considered how best to attack the device. This didn't look particularly easy, as it seemed to be one of those "compact" designs, which our American friends love so well. At first glance it seemed that nothing could be moved until something else had been shifted—if you get what I mean.

There appeared to be three points of access. The deck assembly was held in by four screws and apparently was intended to lift clear to reveal the top of the main chassis. The only snag was that it was anchored to the main chassis by a number of cables from the various heads, motors, switches, etc., these terminating in plug and socket connections on the top of the chassis.

The only way to reach these seemed to be through a small removable panel in the back of the cabinet—except that this was very effectively blocked by the power transformer. I wouldn't say that I couldn't wriggle my hand round the transformer and reach the plugs, but, at best, it would have been a tricky business.

Finally, on the underside of the cabinet, was a fair size removable panel, apparently intended to give access to the underside of the chassis. This was rather more promising, since it came away without any difficulty and revealed the entire "works." This seemed as good a place to start as any, so, armed with a multimeter, I set out to track down the bias oscillator section, the most likely culprit when erase troubles are encountered.

This was not particularly easy in an unfamiliar layout. I started with the erase head on the deck, then, by peering through the hatch in the back of the cabinet, I was just able to make out a cable running from this point down to the chassis. Noting where it passed through the chassis and the socket to which it ran, I finally pinpointed the stage.

VOLTAGE CHECK

This much established, I attacked the stage with the multimeter, even though I was not quite sure what voltages should be present, anyway. However, those I measured seemed lower than I expected, even the main HT line measuring only 120 volts.

As a first step I replaced the rectifier, a 5Y3, and one of the few valves I could reach in spite of the transformer. This made no difference, and I was faced with the problem of deciding whether a HT of 120 volts was reasonable or not.

It was an awkward value. I felt it probably was low, but it wasn't low enough to condemn out of hand. After all, many American designs are based on such HT figures, particularly when it is desired to omit the power transformer.

On the other hand this unit used a power transformer; the unit that was blocking up the access hatch so effectively. Or was it the power transformer? As viewed from the underside, the chasis appeared to have its own power transformer mounted directly on it, and a long way from the transformer at the rear.

Yet the unit at the rear obviously was a power transformer of some kind, because the power leads lead directly into it. The question was: why were there apparently two power transformers? Hardly had the question framed itself in my mind than I felt I knew the answer, even though it bordered on the fantastic.

On the strength of the theory I immediately measured the heater voltage; and when this turned out to be something under three volts I knew I was on the right track.

Next I took another look at the input terminals of the rear transformer. These were mounted on a small insulated panel along with a number of tappings and an adjustable link to allow the correct tapping to be selected. It wasn't very clearly visible in the position it occupied, being partly obscured by the cabinet, but I finally managed to decipher the figures engraved on it.

As I expected, they said, quite clearly, "220," "240," "260." In other words, the unit had been fitted with the necessary 240/110 volt transformer right from the start, but the dealer who sold it had not bothered to mention the fact, probably because he also was unaware of it.

The true history of the machine probably will never be known, but it does seem fairly certain that, although in good condition, it was not brand new. Someone other than the dealer must have fitted the extra transformer to suit his local supply, then subsequently disposed of the unit as it stood.

NO SUSPICION

But without any advice to the contrary, the owner had no reason to suspect any such situation. The additional transformer had been fitted in very workmanlike manner, so that it could easily be mistaken for part of the original unit. In addition, the original spec. plate had been retained on the outside of the cabinet, clearly stating: "110 volts, 60 cps."

So, for several months, the owner had been operating a 240 volt recorder from 110 volts. It is not surprising that it failed to erase correctly; the real wonder is that it worked at all. On the other hand, it might have been better if it had not, since a complete failure would have revealed the true state of affairs a good deal sooner.

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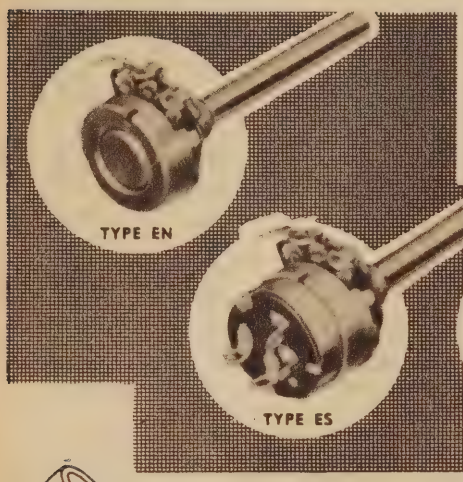

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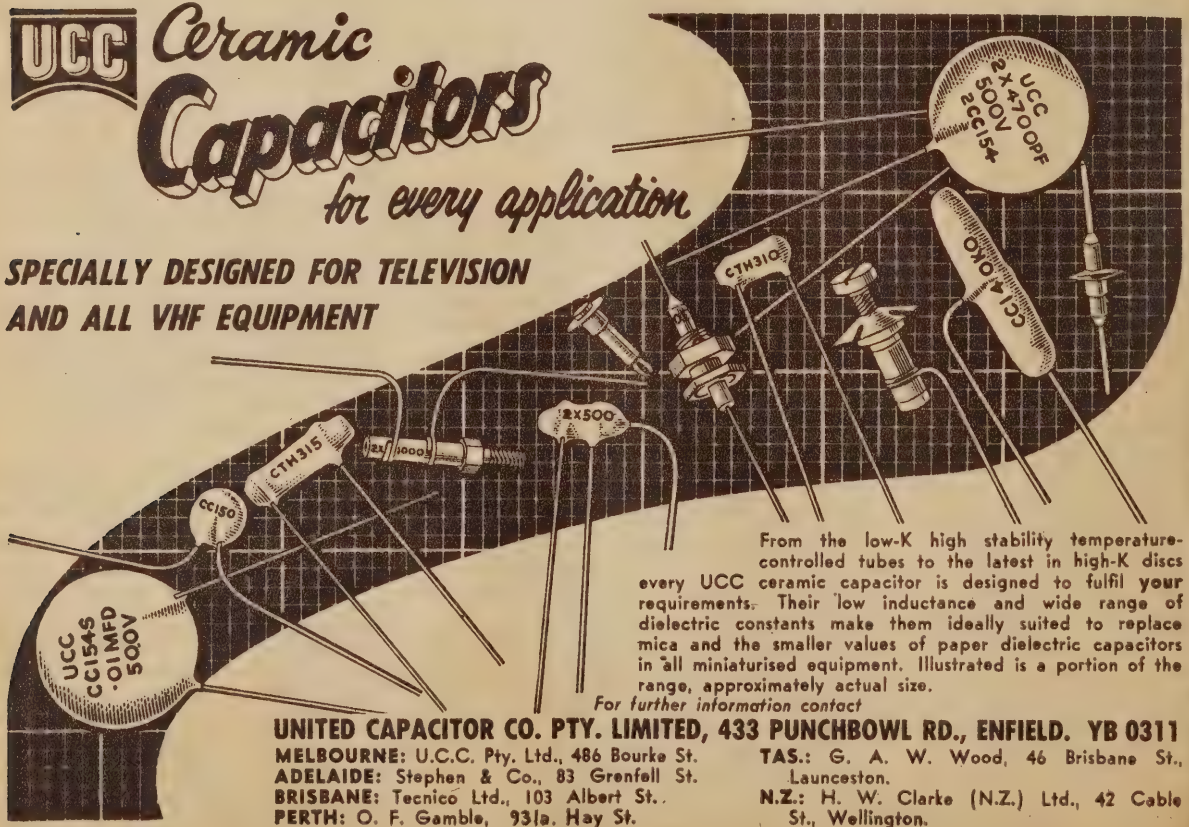

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Naturally, I lost no time in connecting the unit direct to the mains and checking its performance. And, as was to be expected, it behaved quite differently from the way it had done when running on less than half voltage. Everything, including the erase, now worked as I imagined it had been designed to do.

CABLE TROUBLE

The only other thing I could find wrong was a couple of broken cables between the chassis and the deck. One was the shielding braid on the "record/playback" cable, which apparently had been earthed to the deck, but had broken away at this point. The other lead was a simple earth lead of hookup wire from the deck to the chassis.

I managed to solder both these back without too much trouble, although it would have been easier if the extra transformer had not been blocking up the access hatch. (I realise now, of course, that I had done the designers an injustice. They had provided plenty of room to reach the chassis before someone else had added the extra transformer.)

I couldn't be sure whether these repairs had any significant effect on performance. There had been a slight tendency to motor-boating when in the playback position and with certain combinations of volume and tone control settings. It had not been consistent, and I couldn't be sure whether it was due to the broken leads or not. However, after repairing the leads, I was unable to reproduce the effect again, so I assumed that this might be the case.

After a fairly exhaustive test which seemed to reveal no other troubles I passed it back to the owner, along with the story of why it had behaved so poorly. Strangely enough, he did not seem unduly surprised at what had happened—that is, if he really understood what it was all about.

It was several weeks before I saw him again. When I did, he was pushing the recorder across the counter once more. "More trouble," he commented rather grimly, "I'm afraid this thing's turned out to be a bit of a bomb. Fact is, I'm wondering whether it's worth going on with, and I'd like your advice on that point."

He went on to explain that the unit seemed to have lost most of its gain ("punch" as he called it) and that he imagined there might be some distortion in it as well.

FEARS UNFOUNDED

I told him I felt that his fears about the device being a "bomb" were unjustified, since it appeared to be a well designed and well made recorder. The fact that he had had a couple of unfortunate experiences—one of them no fault of the instrument—was mainly bad luck and not really indicative of the order of reliability normally to be expected.

As far as the present trouble was concerned, I felt a good deal happier about tackling it for two reasons. One

TRANSISTOR RECEIVER SERVICE

Dear Sir,

We read with interest the article "From the Serviceman Who Tells" in the current December issue, setting out the likely problems to be encountered when servicing transistor circuits. The section dealing with the type of Voltmeter that should be used caught our attention and we felt that we may be doing a service in advising that such instruments are available.

In our opinion a Serviceman who intends to work on transistorised equipment must be prepared to outlay a reasonable sum of money, since we do not consider that the usual Multi-range Meter or Vacuum Tube Voltmeter would be satisfactory.

As pointed out in your article, a special meter is required. Two (2) instruments which satisfy this requirement are the TAYLOR Model 100A, 100,000 ohms per volt Multi-range meter, and the AMOS Model 140 transistorised D.C. Voltmeter. The lowest voltage range on both these instruments is 500 milli-volts F.S.D. with a minimum reading of 50 milli-volts.

Full specifications on these instruments are available.

In addition to the Voltmeters discussed a very wide range of transistor testing equipment is available and these are priced from as low as £25/10/ each, plus sales-tax. Full specifications on these instruments are available.

We draw these matters to your attention as it is not generally realised that such equipment is available. Initially, manufacturers were the main users of equipment of this type and the servicing of transistorised portable radios and similar equipment was carried out by a limited number of service organisations.

However, with the growing popularity of transistor radios, service organisations must give consideration to the necessary equipment and the training of staff in this new problem. We felt that your article was excellent and of great value.

In all capital cities today it is most difficult to find a service organisation willing to accept transistorised equipment for service and the challenge must be met.

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(Signed) N. E. Goodwin,
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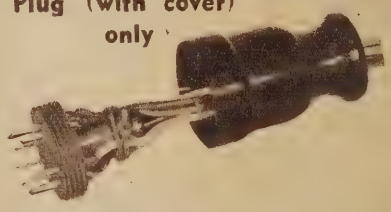

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was that it appeared to be a simple amplifier fault, and the other the fact that the makers had come good with a copy of the circuit.

A quick test confirmed his complaint. There was no doubt about the lack of gain, there being less than enough with which to make a reasonable recording, or to play it back adequately. Compared with its previous performance it was very poor indeed. The distortion, though present, was not so obvious, and might have been overlooked by many people.

Tackling the underside of the chassis again I commenced checking voltages. The main HT voltage was about 260 volts, which was normal according to the circuit, but I struck trouble when I reached the plate of the first amplifier stage.

PLATE VOLTAGES

This was one of four triodes — two 12AT7's—in cascade and was supposed to have a plate voltage of 50. The best I could do with the VTVM was 10, while the following stage, marked as 65 volts, was very little higher.

The next two plates were supposed to have about 120 volts on each, but I could barely rustle up 25. Whatever the precise cause, the fact that four plate circuits were being deprived of voltage in this way was a good enough reason for the poor performance.

A more detailed check revealed that the first two plate circuits were fed through a common decoupling resistor, and the second two likewise. And, since both resistors checked normal, I turned automatically to the decoupling capacitors. Both were 20 mfd electrolytics and both proved to be leaky.

One was showing physical evidence of distress in the form of a distinct bulge and a crop of white blisters on the cardboard case. Unfortunately, this was on the underside and completely hidden from view until I removed it. Otherwise I might have found the trouble with even less bother than I had.

SIMPLE REPAIRS

Repairs were simple. A couple of local 24 mfd types in place of the faulty ones quickly restored the missing volts —and the gain. However, I couldn't help wondering about the failure of those electros. By the standards of a new instrument the failure was very much premature, particularly as two were involved. I felt that it lent added weight to the idea that the unit was not really new when the present owner bought it.

However, that is all speculation, the important point being that he is now very happy with the instrument, which has been going for several weeks without any other signs of trouble. Here's hoping it stays that way.

And, finally, here is a little story related to me by a colleague. Since he told it to me against himself, with no excuses, I have no hesitation in giving it the title, "How Silly Can You Get?"

My friend, who has been building sets for both pleasure and livelihood for more years than either of us care to dwell upon, was building one of the new R., TV and H. Program Sources for a customer. It was about the third order he had had, and he was really getting the feel of the layout and wiring. Parts were dropping into place with only an occasional look at the diagrams, and he reckoned this one would be finished in record time.

It was, too, and after a quick check over the wiring and a couple of hearty bashes on the bench to knock out any surplus solder, he plugged in a set of valves, hooked up a power supply and switched on. He was happy to note that the unit seemed quite lively, with a normal background noise, and even happier when he turned the dial and brought in a couple of stations.

"She's right," he told himself, without bothering to note particularly what stations had been received, and set about connecting up the generator for alignment. When the two IF transformers peaked without trouble and the sensitivity proved normal, he felt really confident this one would go straight through without a hitch.

The shock came when he started on the aerial and oscillator adjustments. 2FC was somewhere on the high side of 2GB and nothing he could do with any of the adjustments could shift it by any appreciable amount. Since it was obviously something to do with the oscillator circuit, he went over this part of the circuit in detail. The padder was taken out and measured, the coil connections checked, and even the oscillator trimmer scrutinised. Everything appeared to be exactly as it should be.

This only left one possibility: the oscillator coil. Muttering dark threats about what he would like to do to the coil manufacturer he prepared to pull it out and try another one. Then a marking on the side of the can caught his eye. He blinked, shook his head and looked again. There was no doubt about it, it said "AER."

With a sinking feeling he turned his gaze on the coil occupying the aerial position. With equal certainty the marking said "OSC." He had carefully wired the two coils in opposing positions and, by a singular coincidence, the aerial coil had elected to function as an oscillator; though, of course, at very much the wrong frequency.

I'm afraid I can't repeat what he said.

STereo V

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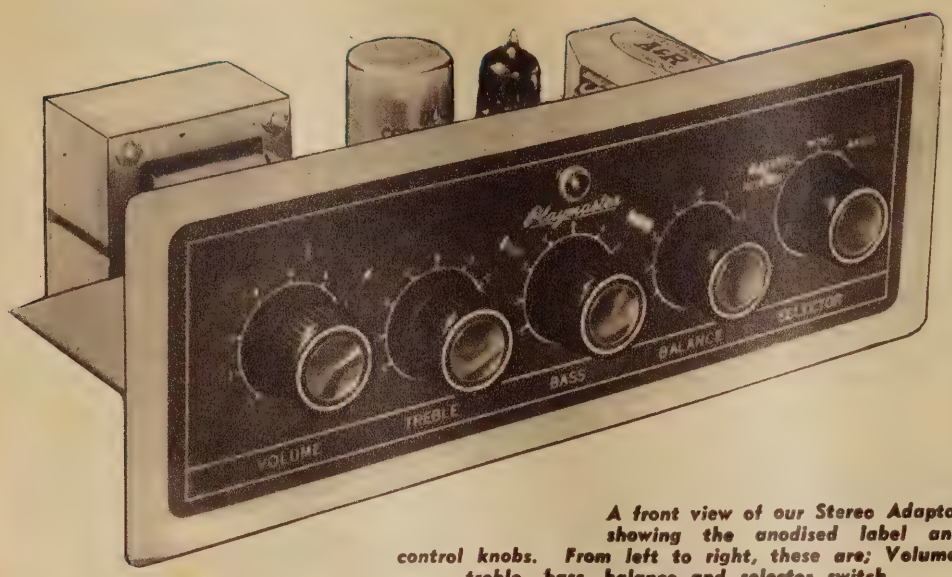


A front view of our Stereo Adaptor showing the anodised label and control knobs. From left to right, these are; Volume, treble, bass, balance and selector switch.

Adapt Your "Gram" For Stereo Records

Here is a project which is designed to help those who would like a stereo system but who are unable, for one reason or another, to install complete new equipment. By building this unit or something very like it, the present radiogram can be adapted without too many complications.

THAT stereo is here to stay is no longer in doubt—if, in fact, there ever was such. Whether related to high fidelity, or any other kind of fidelity, two channels, properly related, can add enormously to the presentation of sound.

There is far more to it than the mere ability to hear different sounds issuing from the separate speakers. This serves very nicely to demonstrate that the system is working as it should and every stereo enthusiast has some pet tracks on his discs which seem best to show up the "gimmick" aspect.

COMPROMISE

But the real satisfaction is in achieving the sense of sound from an appropriately broad front, which can be analysed and enjoyed selectively and almost unconsciously, as one does when listening to the original source.

But none of this makes very entrancing reading to those who have not too long ago finished paying off a bright and shiny mono. radiogram. The idea of scrapping it forthwith in favour of something bigger and shinier—and more expensive—is no more acceptable than that of going without stereo indefinitely.

Hence the thought of compromise, of some kind of adaption.

Frankly, we don't think that stereo adapters can be any more permanent in the scheme of things than any other kind of adapter, but they do serve an interim purpose.

As we see it, nobody who wants stereo is going to be really satisfied until they own a twin, balanced amplifier with balanced speakers, or some equally desirable hybrid system. But in the meantime, what?

Technically, however, there is no special reason why good results should not be obtained by using a supplementary amplifier and speaker with an existing radiogram. Provided they are reasonably similar in sound quality and suitably placed in the listening room, excellent stereo should be obtainable.

The problem of adaption boils down to the following:

(1) Provide and fit a suitable stereo pickup or cartridge.

(2) Provide a supplementary amplifier and speaker.

(3) Provide a suitable control system so that pickup outputs are directed into the respective amplifiers, without complexities which only the originator can understand.

Taking these things in order, the first can be either very difficult or very simple.

It may be difficult in old-style radiograms, with odd magnetic pickups or crystals with fixed cartridges, particularly where these are part and parcel of a changer mechanism. It may be out of the question to fit a stereo turnover cartridge or, having done so, to keep the weight down to the requisite low figure.

To be sure, a whole new pickup may be substituted, but only if you are prepared to drill holes and probably sacrifice the changer operation.

At this point a new stereo playing deck or changer seems indicated as the first requirement.

Against this, there are plenty of pickups in service fitted with turnover crystal cartridges, the latter held in brackets with what are regarded as "standard" ½-inch mounting centres. In many such cases, a stereo cartridge can be located which is a direct replacement or, at least, capable of very easy adaption.

An the best of these cartridges are very good, notably those where quality has not been sacrificed in an effort to gain the last bit of signal output.

Their separation of stereo signals is excellent and, contrary to earlier expectations, they play mono. and 78 records a good deal better than their mono. counterparts of a couple of years back.

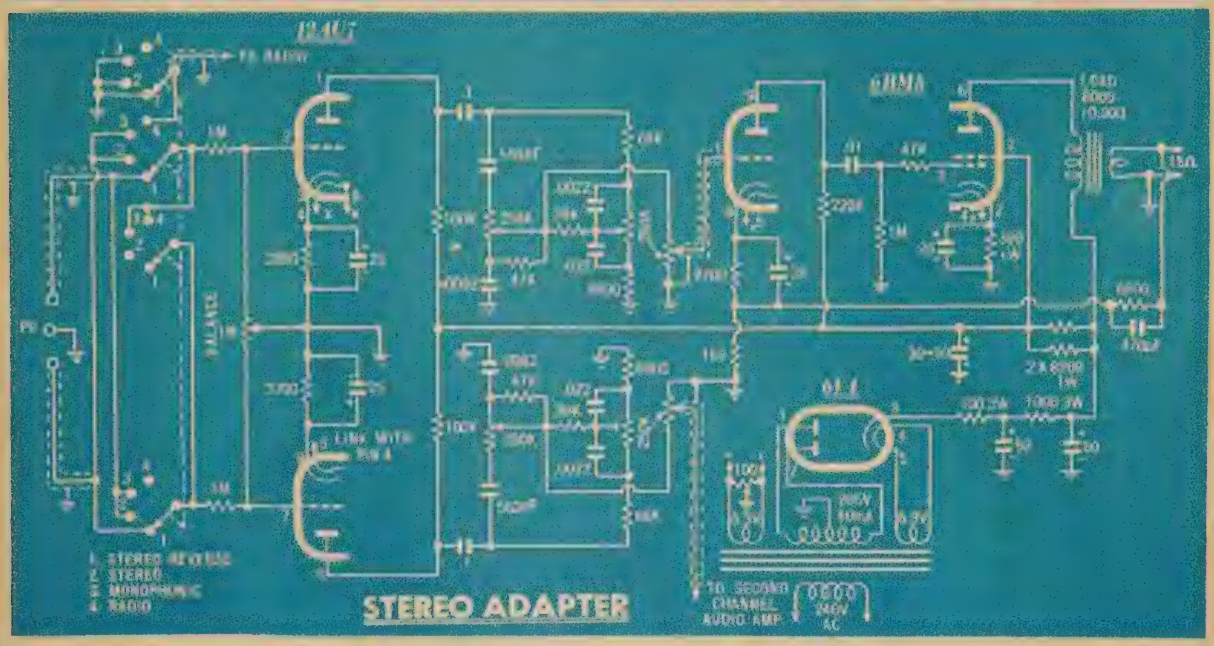
DIFFERENT PROBLEM

In all cases it will be necessary to provide a second run of very fine shielded wire along the arm and down through the base of the pickup. In some, it may be necessary to modify the spring or contrive a counterweight to reduce needle pressure, but such things should not be beyond the capacity of an amplifier enthusiast.

The second amplifier and speaker is a quite different problem and the answers to it will be legion. In some cases, where equipment is already on hand, an excellent course is to build our Crystal Stereo Control Unit (July 1959) and arrange its output to feed the existing radiogram and the supplementary amplifier.

In this present case, we have assumed that no such equipment is available and that you have to "start from scratch." On this basis, the unit pictured is a quite attractive proposition. Alternative-

CIRCUIT DETAILS OF THE NEW STEREO ADAPTER



The circuit of our Stereo Adapter is essentially simple. Resistors are half-watt types unless otherwise indicated. Resistors and capacitors used in the tone control network should be 5 per cent types and reasonably matched. The fourth section of the selector switch is used to silence the radio input when playing records.

ly, it may provide an idea on which you may care to build.

In essence, the unit is our standard stereo control circuit, to which has been added one simple power amplifier and an in-built power supply. It takes full care of the stereo signals from the pick-up and operates the supplementary speaker, diverting the second half of the signal into the radiogram via its normal pickup terminals.

The whole unit is attractive in appearance and relatively small, so that it can be housed in a lacquered metal or polished wooden cabinet of your own choosing and placed either alongside or on top of the existing radiogram cabinet, No trailing wires need to be obvious.

The unit, as shown, has been laid out to use the standard enamelled Control Unit panel, with matching gold-centred knobs. The functions are identical with those in our high-quality Control Units and all the knobs are clearly marked.

In use, the two active leads from the pickup cartridge would go direct to the plug-in connectors at the rear of the adaptor. One half of the signal would be amplified internally and fed through the speaker outlet to the supplementary speaker.

The second half of the signal, after preliminary amplification and balancing, would pass through a short length of coax. cable to the normal pickup terminals of the radiogram, to be amplified and reproduced from the gram's own speaker.

This way, no internal connections whatever need be made to the radiogram chassis and its Pickup/Radio function switch will operate normally.

However, if you feel a little more enterprising, and have the necessary know-how, there is no reason why the "radio" signal should not be separated and run into the "radio" input of your supplementary unit, so that the entire control function will be centred therein.

Two points arise to complicate the picture, namely the setting of the volume and tone controls in the radiogram, which must interlock with those in the supplementary unit.

Seemingly, the obvious course would be to set the radiogram's own Tone Control for level response. This will, in most cases, simply mean turning the control for maximum treble. If the radiogram has a more complex type of control, it may be possible to discover a position for it which gives the closest possible balance between the sound quality issuing from the two speakers.

POSSIBLE DIFFICULTIES

This can be done easily, by the way, by switching your unit to "Mono" and swinging the "Balance" control so that the sound is heard in turn from the two separate speakers.

The Volume Control can be adjusted in one of two ways. One is to turn the radiogram volume to maximum as a standard procedure, relying entirely on the "Balance" control in the supplementary unit to achieve balance between the channels.

Possible difficulties of this scheme may be a tendency for the radiogram to produce an audible hum in these conditions, or excessive gain in the channel, rendering manipulation of the Balance control unduly critical.

The alternative is to operate the Balance control at near centre setting and advance the radiogram volume to achieve equal average output from the two channels. To allow this to be repeated, drill a small hole in the knob and fill with paint so that the radiogram can be "set up" by switching to "Pick-up," setting the tone control as suggested and the Volume Control with the spot upwards.

Thereafter, the whole combination should work as a normal stereo system, with all control concentrated in the supplementary unit.

You should find that the system plays stereo records very well and you may be very pleasantly surprised at the sound of your favourite Mono. records, when issuing from separate parallel channels. More that that, you may be surprised at the way these modern cartridges track the old 78 discs, in many cases with a lot less tracing distortion than has been evident with older and conventional pickups.

So much for the general idea.

Electrically, as we have said, the front end of the unit and all the controls are identical with our standard stereo Control Unit. No great elaboration is necessary at this point.

The power supply, filter system and output stage is open to a good deal more variation.

We have gone straight out for compactness with economy and, for this reason, have suggested a single 6BM8 serving as the complete supplementary audio system. With a good output transformer and speaker, it makes plenty of noise in a small room, particularly when it is remembered that it will be supplemented in practice by another channel giving equivalent output.

The 6BM8 is wired as a conventional two-stage single-ended amplifier, with feedback from the voice coil winding back to the voltage amplifier cathode. The transformer pictured and the feedback constants are for a 15-ohm secondary. This figure is becoming more commonplace nowadays with the less expensive speakers, as well as for the big wide-range jobs.

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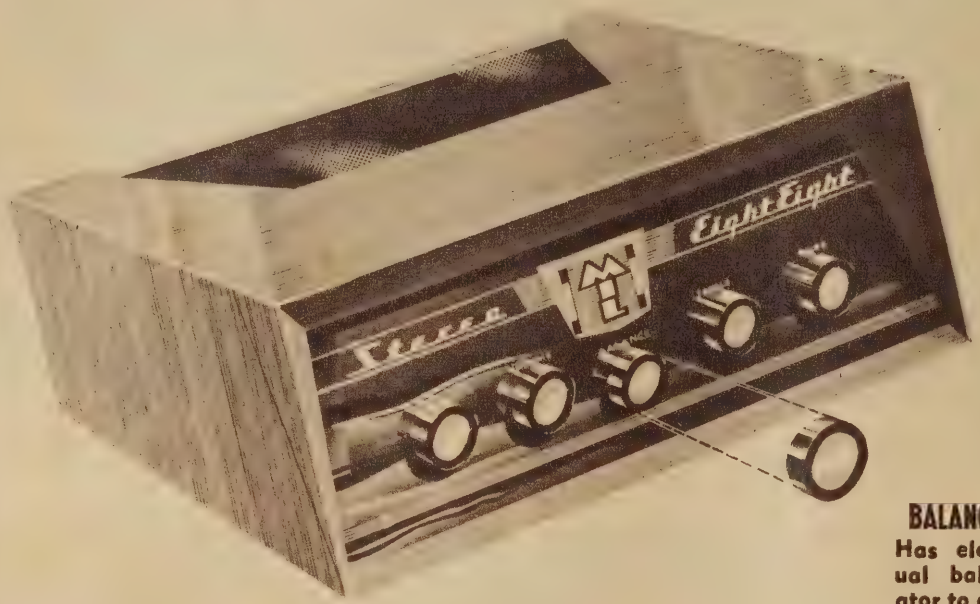

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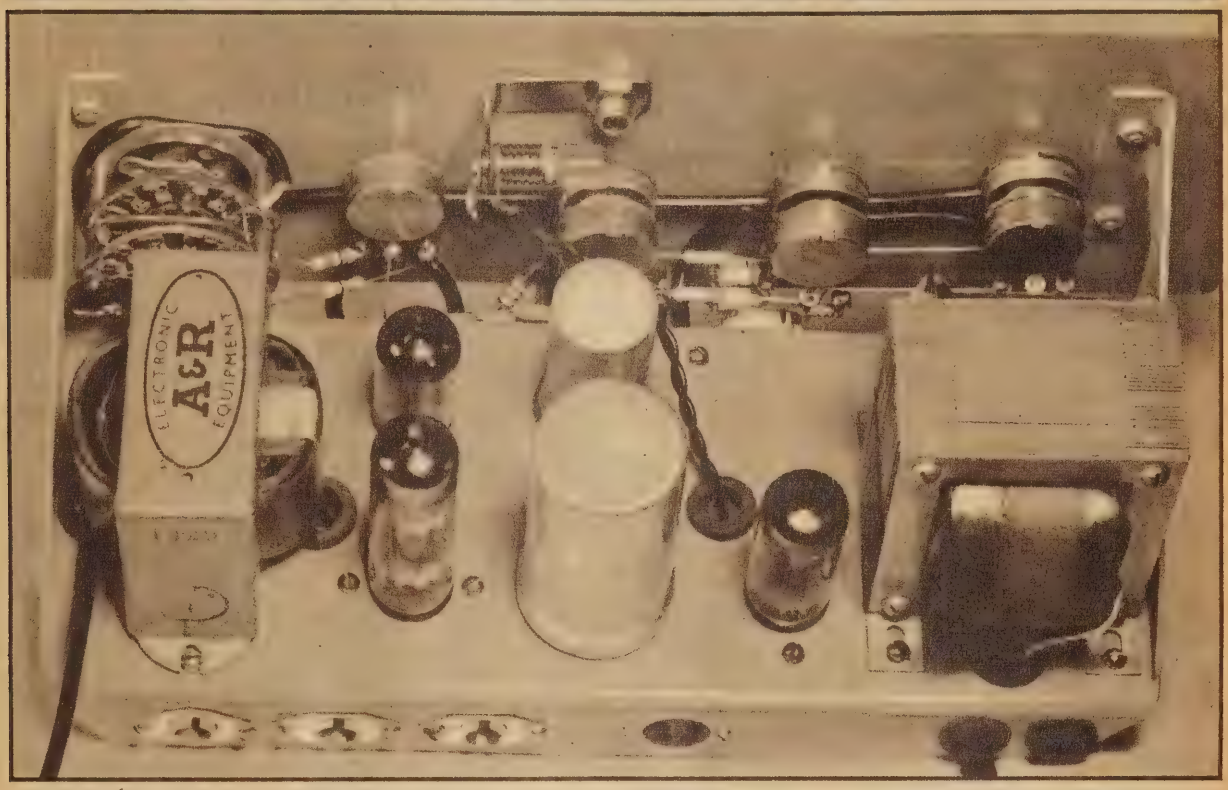

This rear view gives a clear idea of the major component layout. In the left foreground is the 6BM8 valve; to its right is the 6V4 rectifier; a twin 50 mfd electrolytic is interposed between them. Note that the output and power transformers have their cores at right angles to each other to minimise possible hum pickup.

the new twin-cone 8in or 12in, 15-ohm types, mounted in a "boffle" or vented enclosure.

If you have a suitable speaker on hand, it would be necessary to use an output transformer to suit. If the secondary impedance is in the 2 to 3-ohm region, the feedback resistor would need to be reduced to about 2,700 ohms.

Don't forget, by the way, that the polarity of the feedback has to be established by trial and error. If connection of the feedback INCREASES the gain of the amplifier or makes it howl, it is the wrong way round; the polarity of either primary or secondary must be reversed so that connection of the feedback REDUCES gain.

The power supply shown is likewise a simple affair, using a 40-milliamp transformer and resistance filtering with two can-type capacitors. The resulting hum level is acceptably small.

Measurement may show that the transformer is delivering slightly more than its rated maximum HT secondary output but this is easily offset, in terms of total transformer loading, by the fact that the heater windings are not fully loaded.

It is quite possible that individual readers may have valves on hand which, in combination, will deliver more power than a 6BM8 and, of course, draw more current. But then, a larger power transformer may be available, together with filter chokes and other filter capacitors.

The chassis could readily be enlarged to accommodate a more expansive approach, without too much bother. However, make sure that the entire input circuit earths back ONLY to the pick-up input plug, as in the prototype, and keep all input wiring well away from the power supply and output circuitry.

Overall gain with the 6BM8, using feedback, is quite modest so that it should normally balance well enough with the audio system in a simple radiogram. Whatever the relationship, however, the Balance control will be sufficient to achieve equal average output from the channels since, in its extreme settings, it actually cuts the respective channels right off.

TWO COURSES

Most of our tests were done with the Acos 73-1a turnover cartridge and the output on typical discs was sufficient to load the system fully, with a little to spare. This is a good way to have things, since excessive pickup output or excessive gain could lead to preamplifier overload—the volume control in this case coming after the preliminary stages.

Should the gain prove inadequate for any reason, two courses are open.

The first is to use a cartridge with higher output. This is not the preferred method, to our mind, since the tonal quality from the higher output cartridges is likely to have suffered by the change. It certainly seemed to be the case in a couple of examples which we tried.

The second course is to raise the gain of the preamplifier by using a higher gain twin triode. A number of lesser known twin triodes are available which can be treated, in this case, as plug-in replacements for the 12AU7. These include the 12AY7, an expensive medium-mu non-microphonic type, the 12AV7, 12AZ7 and the 12AT7, which is an RF type and likely to be somewhat microphonic.

Then, of course, there is the very high gain 12AX7. Using this with the 73-1a cartridge indicated that the Unit was just about hitting overload on peaks, so that this valve would only be considered for a very low output crystal cartridge. One of the lower gain types mentioned earlier would therefore be preferable.

We were concerned at the posibility of high frequency loss due to Miller effect with higher gain tubes. However, while such loss is evident, it is still within the scope of the treble control potentiometer to correct, even in the worst case, with several db of boost still to spare. It can therefore not be regarded as a serious problem.

And now for a few construction details.

The adapter unit was built on a chassis measuring 10in x 5in x 1 1/8in deep. The ends of the chassis were bent up to form brackets to which the front panel attached. The front of the chassis is cut away to allow for the controls and their wiring. The rear of the chassis is bent to form the rear lip.

Whether blueprints will be made available will depend on the demand for them. We envisage many hobbyists making variations to suit their requirements, while those adhering to our layout should have no difficulty in bending and cutting a suitable chassis from 16 gauge aluminium.

Commence by mounting the major components which should logically fall into sequence. A study of the accom-

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11 "Q" Meter	109 18 9	32A Oscillograph	143 7 6	171A V.T.C.M.	57 8 0	DO 300M Crystal Probe	5 7 0
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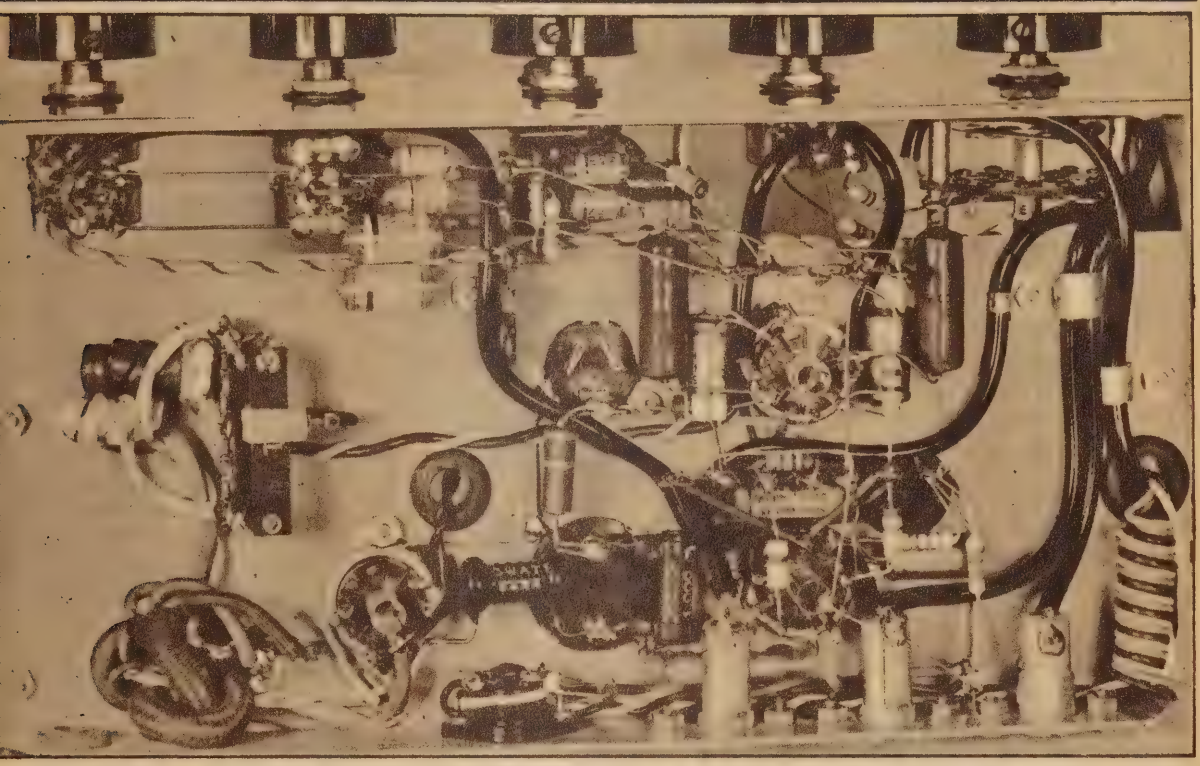
UNDERNEATH VIEW OF THE ADAPTER CHASSIS



The underchassis view shows that the minor component layout is compact but not overcrowded. Although the layout is not extremely critical, we suggest that you follow ours if only for the sake of neatness. Do not forget to observe the single point earthing technique mentioned in the text.

anying photographs should be of assistance in this respect. The power and output transformers must be mounted at right angles to each other for minimum hum pickup.

Valve placement is not critical and these should so proportioned as to provide adequate space for the associated wiring. Their relationship to the controls and selector switch must also be kept in mind.

The tone control wiring and minor components are grouped and suspended between the controls and a tag strip. Likewise the wiring and components in the first stage are grouped and suspended between tag strips and the socket pins.

While we are on the subject of the tone controls and the control stage, we must bring to the readers' attention a very important point, which could well determine the success or failure of the project.

The point in question is that of earth returns for the tone control stage and to a lesser extent for the triode driver stage.

In the interests of keeping hum to a minimum, it is essential to employ a single earth return point technique in the earlier stages.

Since the input sockets are necessarily earthy, the various earth returns should be routed to finish at, or near the input sockets. This should not be difficult to accomplish with the aid of tag strips. "Earthy" wires should not make contact with the chassis at any intermediate points.

The following connections will need to be shielded: From the input sockets to the function switch; from the balance control to the grids of the twin triode; the outgoing leads from the ganged volume control. Coaxial cable is ideal for this purpose, since it is insulated as well as shielded, facilitating single point earthing.

In no circumstances must any of the shielded leads run close to the transformer whether above or below the chassis, as hum pickup will result.

NEAT LAYOUT

When purchasing components, select the smallest available. Small components will assist you in preserving a neat layout and avoiding overcrowding.

Looking at the under-chassis view, you will note that the incoming AC leads are anchored to a 3-lug strip. This strip also supports the transformer primary leads as well as the secondary centre tap and electrostatic shield leads.

Directly above it is a five-lug strip which supports the leads of one of the 6.3 volt windings and its centre tapping resistor. The 12AU7 and 6BM8 valves are operated from this winding. The second 6.3 volt winding supplies the rectifier and the pilot lamp.

Along the front edge of the chassis you will see a five-lug strip used to support the tone control wiring and components which swing between the strip and the potentiometer lugs.

To the right is another five-lug strip supporting the components of the first stage and the interconnecting leads to the tone control network.

Directly below the twin triode socket is a six-lug strip which carries some of the components of the first stage as well as those of the following stage. The 6BM8 triode cathode components return to a lug on this strip and the feedback connection is made at that point. Do not omit to return the voice coil and feedback network to the common earth point.

The high tension filter and decoupling resistors are suspended between the lugs of the electrolytic capacitors which are suitably located. Three-watt resistors should be adequate for the filter network, while the decoupling resistor must be capable of handling about 2 watts and may be made up of two 1 watt resistors in parallel.

We have used can-type electrolytics to conserve space and to enable us to decrease the chassis depth. Wiring is simplified as well, by obviating the use of tag strips.

The voice coil output is taken from a four-pin socket on the rear lip of the chassis. The feedback constants may be mounted across the lugs of this socket.

Having completed your adapter you will naturally wish to check its performance. The following readings should act as a guide. The figures are approximate, a few volts one way or the other being in order.

Measuring from the output plate to earth you may expect about 250 volts; from the output screen to earth, about 210 volts; at the output cathode about 16 volts; total HT measured at the second filter capacitor 270 volts; total current drain about 46 mA.

At the 6BM8 triode cathode and each of the twin triode cathodes you may expect 1.2 volts and 2.5 volts each respectively. The power output should be between 2-3 watts depending on the output transformer used.

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AUTODYNE FREQUENCY CHANGERS

The Autodyne converter, so widely used in this country in early superheterodynes, is re-appearing in some overseas receivers. This article from the American Sylvania Company discusses the trend and the circuits involved.

IN the course of servicing radio and television receivers, the serviceman has familiarised himself with various kinds of frequency conversion circuits.

We might say that in general, there are three basic types of frequency conversion circuits. Oscillator-diode such as is found in UHF-TV tuners and converters; oscillator-triode (pentode) such as is found in VHF-TV and FM tuners; and the pentagrid converter which is most generally found in radio-receivers.

Early in the 1930s, both the pentagrid and autodyne converters were developed. At that time, due to the fact that the autodyne circuit had a higher gain than the pentagrid circuit, the autodyne was more widely used than its counterpart.

AVC PROBLEM

Later, however, when automatic volume control was developed, the autodyne dropped from the scene since the application of AVC voltage only produced "motor-boating," or loss of oscillation.

Recently, the autodyne has begun to make a return and is currently being employed in a number of AM receivers. Two of the factors contributing to the return of the autodyne are: (1) With the addition of a diode and a circuit modification, the conversion gain may be changed by the application of AVC voltage; and (2) A change in the listening habits of the public in general.

Most housewives today are content to listen to the local broadcast station; thus receivers are currently being manufactured with little or no AVC. An autodyne converter is simply a self-oscillating mixer. That is, all of the elements involved in the generating of the local oscillator signal also take part in the mixing action, and vice versa.

One basic form of the autodyne is shown in Figure 1. The received signal is selected by the tuned circuit (L1, C1) in the input transformer T1 and impressed on the control grid of the triode.

OSCILLATOR FREQUENCY

The triode oscillates at a frequency determined by the tuned circuit (L2, C2) in the transformer T2.

As a result of the large oscillator voltage and the received signal voltage being combined between the cathode and the grid, the plate circuit produces a signal current which is the received signal converted to a frequency equal to the difference between the received signal frequency and the frequency at which the triode is oscillating. This we call the IF frequency.

The IF signal is then coupled out of the circuit by means of transformer T3 which, in turn, delivers the signal to the

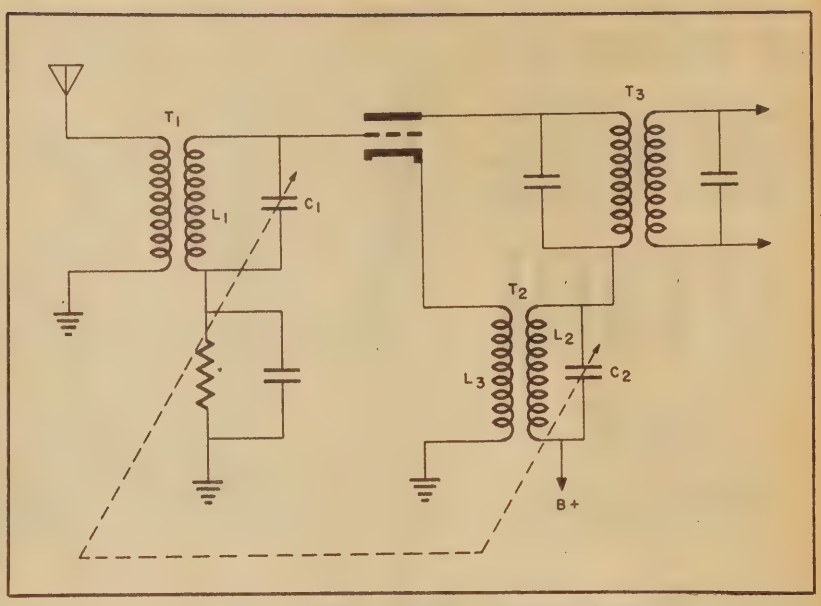

Figure 1. A basic autodyne converter circuit.

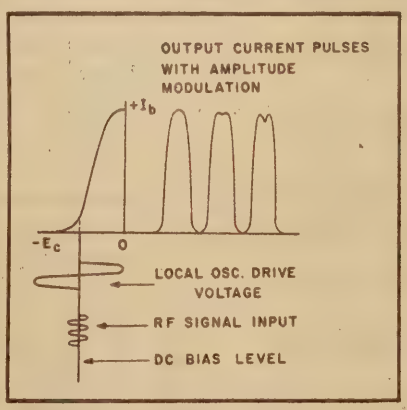

Figure 2. Typical triode mixer transfer curve.

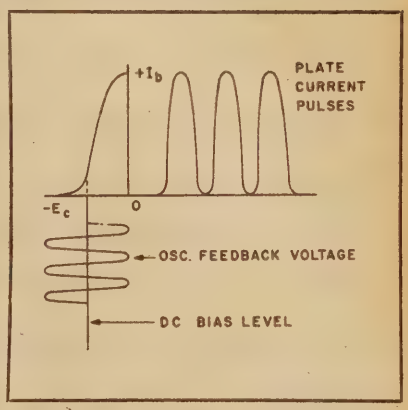

Figure 3. Typical oscillator triode transfer curve.

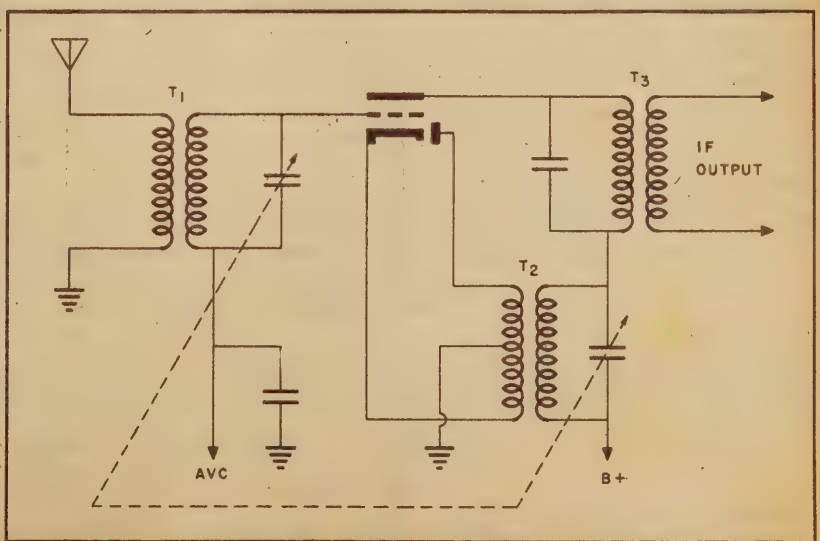

Figure 4. Autodyne converter with diode to make possible use of AVC.

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first IF amplifier stage for further amplification.

To better understand how it happens that the desired difference signal is produced in such a simple circuit, it would be advantageous for us to review the theory of a simple triode mixer and then a triode oscillator. Following this we will see how the same triode may be made to perform both functions at the same time, as is done by the autodyne circuit.

Let us consider a triode, which has impressed on its grid two signals, one, a very large signal, produced by a local oscillator, and the other, a small signal, which is the received or incoming signal.

The local oscillator signal, being large, will cause the plate current to fluctuate between zero and maximum plate current as shown in Figure 2. Likewise, the transconductance will vary from zero to maximum Gm. As a result of the magnitude of the oscillator drive, the plate current and transconductance becomes a series of pulses. The amplitude of these pulses is modulated by the incoming signal.

MIXER OUTPUT

As a result of this modulation, the plate of the mixer produces not only pulses at the local oscillator frequency rate and the resultant harmonics, but also side bands above and below the local oscillator signal current and each of its harmonics.

Of particular interest to us is the lower side-band, which is at a frequency equal to the difference between the local oscillator and the signal frequency. This is better known to us as the IF frequency. This component of the plate current is coupled out of the circuit by a suitable tuned circuit and then amplified in the next stage.

Now let us examine a triode oscillator circuit. Here we see the triode working as an amplifier with its output coupled back to its input. This feedback circuit is tuned to a frequency which establishes the proper phase relation between the input and output of the amplifier.

As a result of the oscillations becoming larger and larger each time they are fed back and re-amplified, the grid-cathode swing becomes correspondingly larger. After a few oscillations we see that the tube is at maximum gain part of the time and at zero gain part of the time.

AVERAGE GAIN

The average gain is then some point between zero and maximum determined by the developed grid-cathode bias. The developed grid-cathode bias is thus a self-limiting voltage developed by the oscillator action. At this point, the triode is operating as described by the curve in Figure 3.

The reader should now notice the similarity between the curves in Figure 2 and 3. All that is lacking in the oscillator to make it a mixer is an incoming signal. Therefore, a signal may be coupled into the grid-cathode circuit as is done in Figure 1, to, in effect, modulate the developed oscillator bias.

Then, as before, the plate circuit will have a signal current at the difference frequency. This difference signal is coupled out of the plate circuit by means of an IF transformer as in Figure 1.

It was stated earlier that AVC could not be applied to an autodyne converter. The reason for this is that when a tube is working as an oscillator, it is performing two functions—amplification and limiting. Limiting, you will recall, is accomplished by self-biasing.

If a D.C. voltage (AVC) is applied to reduce the gain of the amplifier, the tube automatically reduces the self-biasing voltage by the amount of the D.C. bias and the gain remains the same. However, as the D.C. bias increases and becomes larger than the amount of self-bias, the circuit begins to "motorboat."

Larger D.C. bias shuts the tube off completely.

To overcome this difficulty, designers have added a diode to the circuit as shown in Figure 4. In the circuit the triode has only one function—amplification, and the diode performs the limiting action.

The secondary of the oscillator tank has two outputs with respect to ground. One, the feedback signal to the amplifier input (cathode) and the other, the diode limiting circuit. Limiting, in this case, is accomplished by loading and not by developing bias voltage.

For example, as the oscillation increases, the diode current increases which increases the load on the secondary of the oscillator tank. This, in turn, decreases the coupling between the primary and secondary of the oscillator tank and, therefore, the amount of signal fed back to the cathode.

The most outstanding advantage of the autodyne converter is its higher gain. This can be readily demonstrated by comparing the autodyne circuit in Figure 1 with a common pentagrid converter circuit as shown in Figure 5. Note that in the pentagrid circuit the tube is required to have two control grids, grids No. 1 and 3, plus another grid, grid No. 2 working as an anode.

CURRENT DIVERTED

To perform the function of an oscillator, the anode grid must intercept a considerable part of the cathode current. If the reader observes the ratio of plate to cathode current for the Type 6BE6, which appears in most tube manuals, he will see that only ¼ or approximately 25 p.c. of the cathode current reaches the plate.

This means that the conversion gain of a Type 6BE6 when used in a

TYPICAL PENTAGRID CIRCUITS

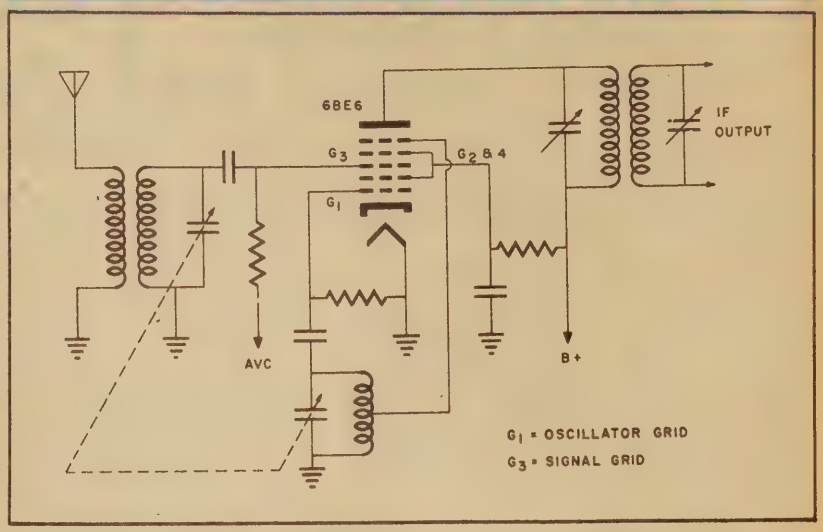

Figure 5. Typical pentagrid converter circuit.

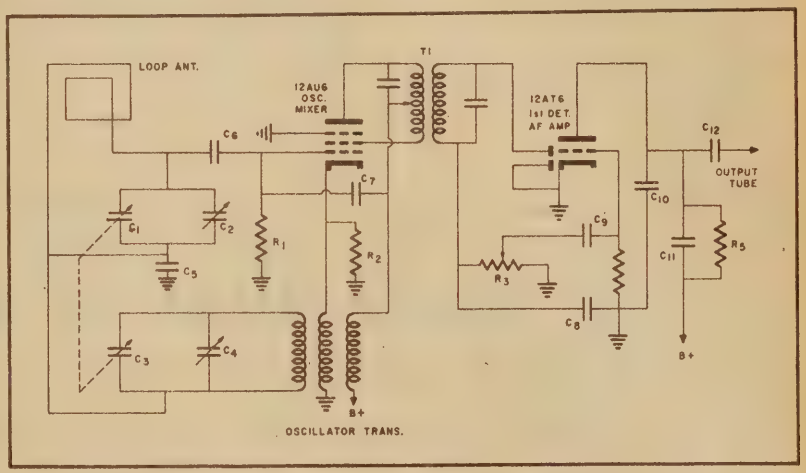

Figure 6. Partial circuit diagram of Sylvania radio chassis 1-629-1, 2.

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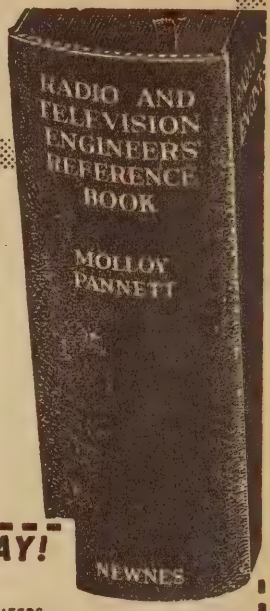

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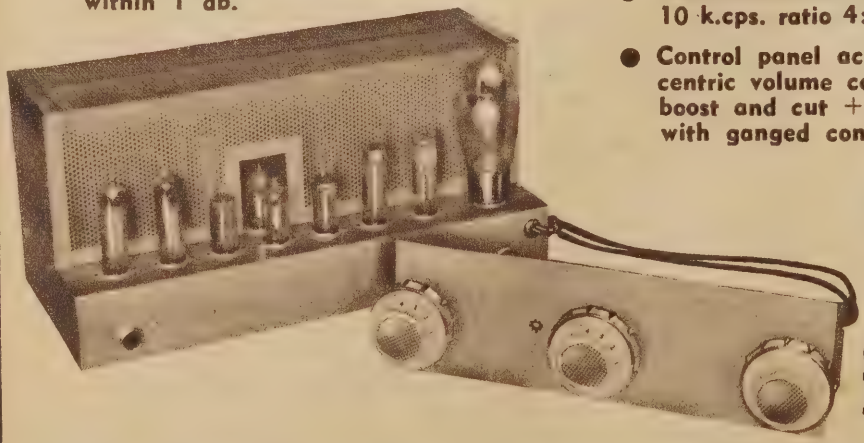

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pentagrid circuit is only 25 p.c. of the conversion gain obtained with a Type 6AU6 in an autodyne circuit. Now returning to figure 1, we see that almost all of the cathode current is plate current. Actually, some cathode current goes to the grid because of oscillator action. Oscillator feedback and the incoming signal are both inserted between the grid and cathode.

In comparing the circuits in Figure 1 and 5, the reader has perhaps noted the circuitry is somewhat reduced and that the tube requirements are less. Thus, circuit simplicity becomes a second advantage of the autodyne circuit.

ing as a pentode with the effective plate resistance being increased by the feedback to the screen grid.

Since the 12AU6 is an oscillator as well as a mixer, it is necessary to make sure the signal input circuit is free of oscillator voltage. This prevents radiation of the signal at oscillator frequency through the receiver antenna.

The capacitor C7 (4.7 PF) is, therefore, connected between the control grid and the IF output transformer tap. This capacitor neutralises any oscillator voltage that might be present at the grid as a result of the tube's interelectrode capacitive network.

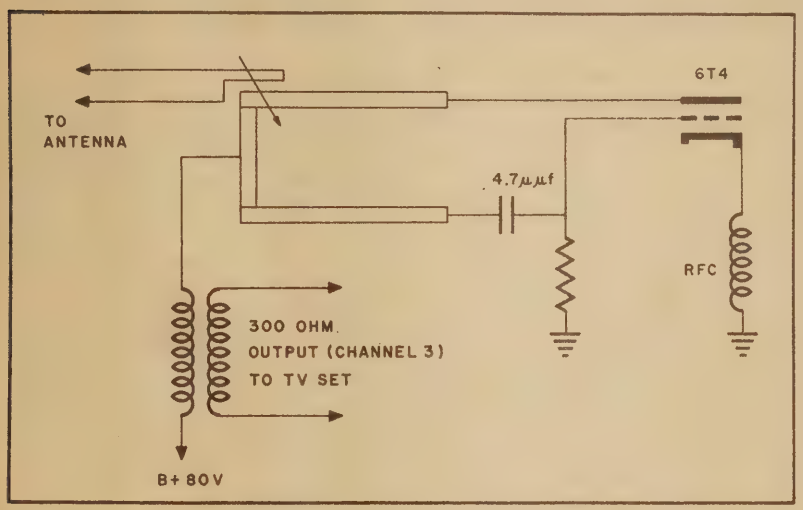

Figure 7. Autodyne UHF-TV converter.

A third advantage makes the first two all the nicer. That is, the higher gain and reduced circuitry are obtained without reduced image rejection or increased oscillator pull or noise.

Figure 6 is a partial circuit diagram of the Sylvania Model 629 radio chassis. After a brief study, we see that V1 (Type 12AU6) is being used in an autodyne converter not too different from the circuit in Figure 1.

Although a pentode tube is used, it is triode connected as far as the oscillator frequency is concerned. At the intermediate frequency, the tube is work-

In the foregoing discussion, we limited ourselves to AM receivers. However, it should be noted that the Autodyne may be used at any frequency at which a triode may be made to oscillate. Also, the method of modulation (television or FM) places no restriction on its use.

In the early days of UHF television, a single tube autodyne converter was used to receive signals from Sylvania's experimental station KG2XDU on Channel 22. The circuit for this one tube converter is shown in Figure 7. In this circuit, the input frequency and the oscillator frequency are so close to one another that one less tuned cricuit is needed.

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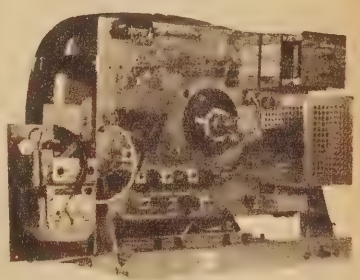

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Here's your answer, Tom!

Judging by this months queries Tom is a budding amateur. As most other beginners in this field he has come up with his share of problems. The queries we have selected and their answers, should assist beginners who have a "ham" ticket in mind.

How is modulation in an AM transmitter accomplished?

In the present sense, Tom, modulation is a combination of the electrical energy caused by a sound wave with a radio frequency wave.

In amplitude modulation the energy of the sound wave is virtually added to or subtracted from the carrier wave, thus altering its amplitude. Whether the amplitude of the carrier wave is increased or decreased depends on the alternating nature of modulating signal.

There are several methods of modulating the carrier wave and plate modulation is the most common.

In the plate modulation method, the plate voltage of a class-C amplifier, which amplifies the carrier wave, is varied in accordance with the modulating signal. Since the carrier wave output from the class C amplifier must vary in accordance with the plate voltage, it varies also in accordance with the modulating signal.

The output of a microphone or other audio device is inadequate as a modulating signal and must be amplified. The amplifier performing this function is called the modulator and is usually coupled to the class C stage through a transformer.

Looking at a simple circuit of a modulator and final stage which we have reproduced for your guidance it will not be difficult to understand the action.

Variations in voltage of the modulating signal appear across the secondary of the modulation transformer, and add to or subtract from the plate voltage of the final. If the variations in voltage of the modulating signal are small compared to the plate voltage of the final, the percentage of modulation will be small and under-modulation will result.

If, however, the peak modulating signal voltage exactly equals the plate voltage of the final, the output from the final will vary from twice its normal amplitude down to zero. This is the most desirable degree of modulattion and is termed 100 per cent modulation.

If the modulating signal voltage exceeds the plate voltage of the final, over-modulation will result, bringing distortion and other problems.

From the foregoing it is evident that the power required from the modulator or audio amplifier is decided by the power output of the final stage. Thus, a high power final stage requires a high power modulator.

Besides the plate modulation method we have just discussed, it is possible to use grid-bias modulation and cathode modulation.

In grid-bias modulation, the modulator supplies the voltage for the bias to the grid of the final. The value of the grid bias voltage determines the plate current of the final and affects the amplitude of the output signal in accordance with the bias variations. Much less audio power is required for grid-bias modulation but, for a given valve, less R.F. power is produced.

Cathode modulation is a combination of the plate and grid-bias modulation methods. The output of the modulator is connected into the cathode circuit, affecting both the grid bias and the plate voltage during modulation.

★ ★ ★

In what respects do resonant and non-resonant transmission lines differ?

That's a pretty tough one, Tom, which we can only answer in a brief fashion.

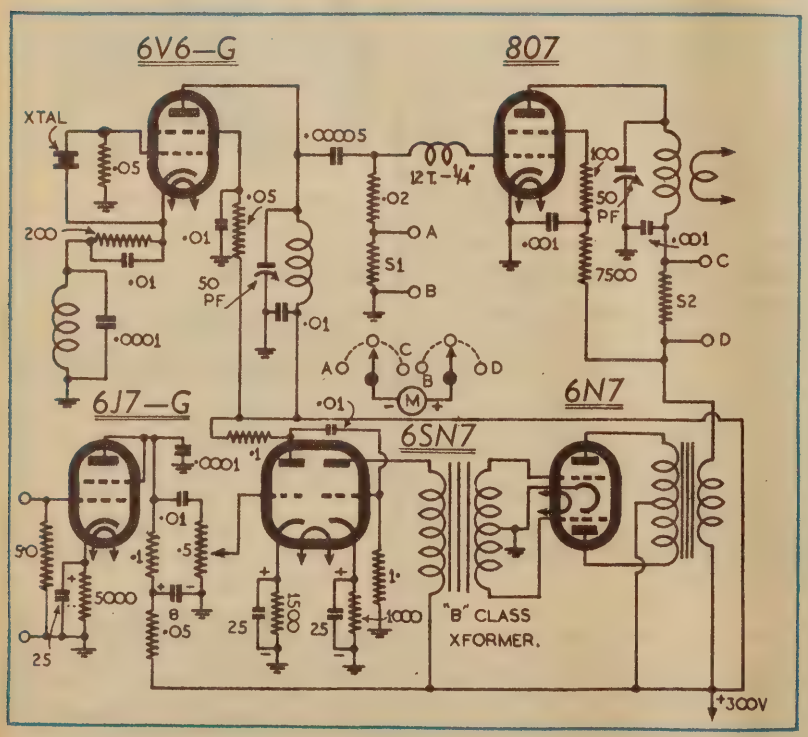
The whole question of resonant or non-resonant transmission lines is tied up with resonant aerials—resonant because they are cut to a specific length, relative to the wave-length or frequency of the signal which they are meant to handle.

Along a resonant aerial, the relationship of the oscillatory (or signal) voltage and current varies. We describe this by saying that there is a "standing wave" pattern on the aerial and that the apparent impedance differs at various points along it.

This pattern of standing waves—and differing impedance—can extend along the feedline carrying energy to or away from the aerial. Once again, we can say that there is a standing wave pattern on the feedline and that the effective impedance of the feedline varies along its length.

At a particular point, the voltage may be high, the current low and the equivalent impedance therefore high. This gives place to the reverse condition a quarter wave-length away, where voltage is low, current is high and impedance is therefore low. A still further quarter wave away, the high voltage, low current, high impedance condition is repeated, and so on.

This natural repeat pattern of high



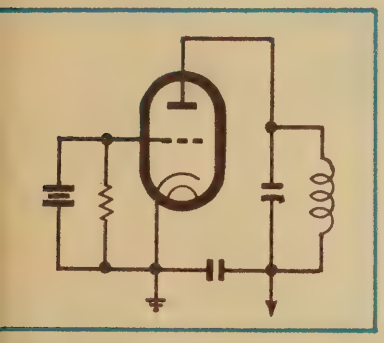
A typical amateur transmitter using plate modulation of the final amplifier stage. Note also crystal control.

nd low impedance points along a feeder an be put to good use as a means of mpedance matching. For example, it ecomes possible to couple a high im- edance. output point from a transmit- er to a similarly high impedance point n an aerial system, without having to se a feeder system which is, by nature, f an equally high impedance.

It merely requires to be an even num- er of quarter wave-lengths long and of suitable order of natural impedance.

Alternatively, by using a feeder con- aining an odd number of quarter vaves, a high impedance point at one nd can be connected to a low imped- nce point at the other, the feeder serv- ng the double role of conveying energy nd also providing an impedance match.

Actually, one doesn't need to be too nuch of a genius to put this theory into ractice, which is fortunate for the many mateur transmitters who use tuned eeders. There are plenty of instruc- ions and tables and graphs available vhich allow those who need to do so, o work out whole aerial and feeder ystems, without too much mental ex- rtion.



Basic circuit for a crystal-controlled oscillator.

However, to sum up and answer part f your questions, feeders can be said to e tuned, when they are cut to a specific ength and used in such a way that the tanding wave pattern, produced along hem, facilitates the proper connection f aerial to receiver and/or transmitter.

Feeders can be regarded as untuned, vhen there is no such standing wave attern along them. This is achieved by rranging an accurate match between the eedpoint of the aerial, the natural im- edance of the cable and the input or utput circuit of the receiver or ampli- er, whichever is concerned.

The natural impedance of a resonant ipole is very close to 70 ohms, but this alue may be increased or decreased by he use of supplementary aerial elements nd/or folding the dipole element.

The natural impedance of a feedline s largely determined by the diameter and pacing of the conductors and by the resence of dielectric material between iem.

The impedance of a receiver or trans- itter is dependent on the aerial coupling nk of circuit.

The simplest illustrative case would be dipole with 70-ohm centre impedance, oupled through a length of 70-ohm twin edline to a coupling coil on the re- iver or transmitter, representing the me order of impedance.

Where suitable impedance matching n be arranged, of this general charac- r, standing wave effects on the line e non-existent or of a minor order. The nominal impedance of the line does not vary along its length, which therefore becomes unimportant, except for pure resistive losses.

Both systems are used. The untuned system is simple, provided the whole set-up lends itself to accurate impedance matching.

On the other hand, where impedance values cannot readily be reconciled or are unsuitable for a "flat" or "untuned" line, it may be more convenient to use a tuned feeder system, even though it may involve an open wire line cut to a specific length.

★ ★ ★

How does "crystal control" in a radio frequency oscillator work?

A piece of quartz crystal, when cut at a certain angle into a thin slice and placed between two plates, will bend or flex if a voltage is applied between the plates. The reverse is also true and, collectively these phenomena are known as the piezo electric effect.

If AC is applied between the two plates, the crystal will bend back and forth at frequency of the applied voltage. Depending on the "cut" of the crystal, there is normally some particular frequency at which individual crystals will vibrate much more readily and this is said to be the natural resonance of the crystal.

This property is put to use in the crystal controlled oscillator. The crystal is associated with an oscillator stage, so arranged that energy from the output of the oscillator valve is applied across the crystal to keep it vibrating at its own natural frequency.

Since this latter is a distinct figure for each individual crystal, and not greatly affected by temperature and humidity, it follows that crystal-controlled oscillators exhibit a high order of frequency stability.

Electrically a crystal behaves just like a tuned circuit with a very high figure of merit—in other words a high "Q" factor. A typical circuit arrangement is shown herewith.

IN GRID CIRCUIT

The crystal is connected between the grid and earth, with a grid leak to complete the DC return path. In the plate circuit is a conventional tuned circuit which includes the crystal frequency in its tuning range.

You will notice that no coupling circuit for the feedback path is provided. This is unnecessary, because feedback occurs through the grid-plate capacitance of the valve. If a pentode were used in this circuit, the plate-to-grid capacitance of the valve would be too small to provide a suitable feedback path and a small amount of external capacitance, from plate to grid, would be included.

When the plate circuit is tuned very close in frequency to the natural resonance of the crystal, the circuit behaves like a conventional tuned-plate, tuned-grid oscillator. Frequency stability is generally of a much higher order, however, even without special precautions being taken.

Where extreme stability is required, the crystal may be kept in a temperature controlled oven.

Because crystals can be fractured by excessive activity, the amount of power a crystal oscillator can furnish is limited. The radio frequency oscillations must normally be amplified by one or more valves capable of supplying the necessary power.

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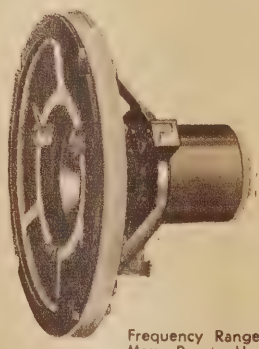

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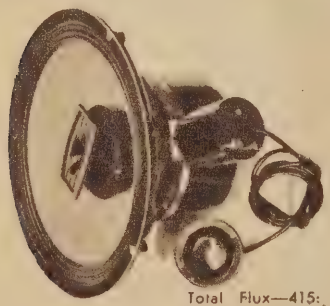

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Total Flux—415: 240,000; 615: 308,000
Frequency Range ..... 20-35,000 c/s.
Fundamental Resonance ..... 25 c/s.
Maximum Power Handling:
415 ..... 20 watts; 615 ..... 25 watts
Impedance ..... 16 ohms

Price:
415 ..... £52/15/-; 615 ..... £76/10/-.

Bass that beats all bass with the

AUDIOM 60 (12")

Not just the "lows," but the lowest register of the musical scale is encompassed and ensured by placing of fundamental resonance.
This high-fidelity loudspeaker is a robust single-cone unit built on a rigid cast chassis. Design features in the coil and magnet system provide linearity of drive of high amplitudes whilst still maintaining high electro-magnetic damping.

Fundamental Resonance ..... 35 c/s.
Max. Power Handling Capacity: 15 watts
Flux Density ..... 14,000 gauss
Total Flux ..... 158,000 maxwells
Impedance ..... 15 ohms

Price: £25/17/6.

BRITISH MERCHANDISING PTY. LTD.
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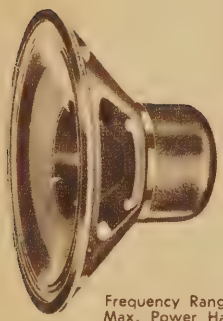
12

BRITISH

HIGH-FIDELITY SPEAKERS

Advances beyond all standards ever before achieved with this type of unit.

AXIOM 300 (12")

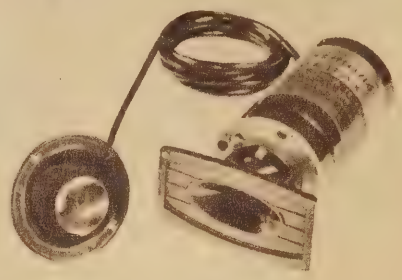


The Axiom 300 — incorporating new developments — not only gives a performance with negligible distortion, but provides the smoothest, most extended response ever achieved in a twin-cone, high-fidelity loudspeaker. Standing waves and spurious resonances are prevented by exacting terminations of both diaphragms.

Frequency Range ..... 30 c/s.-16,000 c/s.
Max. Power Handling Capacity: 15 watts
Flux Density ..... 14,000 gauss
Impedance ..... 15 ohms
Total Flux Density ..... 158,000 maxwells

Price: £29/2/6.

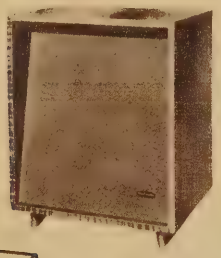
For treble response plus— **TREBAX 35 XL**



This new Trebax pressure-driven, horn-loaded, high-frequency unit now has its own 12 db octave, 5,000 c s. crossover network.
On the back of the unit are screw-type connectors for "INPUT" and "BASS" facilitating connection to loudspeakers carrying your bass and mid-frequency registers.
For high-frequency control, 16-ohm variable L-pad on a 36" cable is provided.

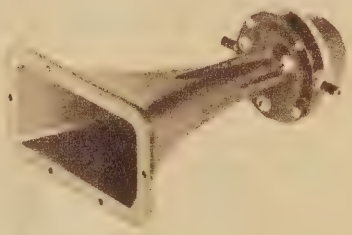
Price: £17/15/-.

CABINETS FOR 1-2-3 SPEAKER SYSTEMS



The SHERWOOD II is designed for single or multiple - speaker systems, incorporating the appropriate Acoustical Resistance Unit.
To blend with any furnishing, these cabinets are available complete in polished walnut or pine; alternately plans are available for those wishing to make their own.

For stereo—cabinets saving space
The Axiette cabinet, ideal for stereo reproduction—specially designed to carry the Axiette II speaker. Plans available.
Sound systems need crossover networks.
The GOODMANS XO-950 and 950 x 5,000 (to suit MIDAX 950) are designed to give that full frequency flawless coverage.
Also available are ARU's for all purposes.
Further information on request.



MIDAX 950—completely free from distortion with high efficiency. The Midax 950 unit is the correct choice when the major advantages of a horn-loaded middle register loudspeaker are required. Making allowance for the overlap regions, crossover frequencies are 950 c/s. and 5 Kc/s.

Frequency Range ..... 650 c/s.-8,000 c/s.
Crossover Frequencies ..... 950 c/s. and 5,000 c/s.
System Power Handling Capacity ..... 25 watts
Impedance ..... 15 ohms

Price: £21/18/6.

Prices quoted are retail and fixed in all State capitals.

MERCHANDISING PTY. LTD.

60 CLARENCE STREET, SYDNEY. BX 1571

A B.M.P. COMPANY

The driver of this boat may not be studying his tachometer at this particular instant, but we can be certain that he consulted it many times before his motor was tuned to the high pitch required for such spectacular performance. The unit described is ideal for such applications.

How Many Revs. Is The Motor Doing?

Almost anyone interested in internal combustion engines — either professionally or as a hobby — can make good use of any simple and reliable device to measure engine speeds i.e., a tachometer. This article discusses the operation of electronic tachometers and describes the construction of a simple transistorised unit.

by Philip Watson

THERE may be many reasons why we need to measure engine speed and, while in a car at least, we may have a speedometer capable of providing this information indirectly, there are many reasons why the more direct presentation may be desirable. In other installations we do not have even this guide to performance, in which case such a device becomes virtually essential.

USE IN CARS

A tachometer is of most value in a car when the latter is to be used competitively in any form. On such occasions it may be necessary to push the motor to the limit of its permissible speed to obtain power, acceleration, etc., and a driver can hardly be expected to go through the mental gymnastics necessary to convert the miles per hour to revs. per minute for each gear in the car.

To complicate matters further it is not unusual to fit such cars with "foreign" gear boxes, differentials, or combinations of these in order to obtain the best possible performance from the motor for a particular competition.

A typical example of this is the Bathurst racing circuit, where drivers and mechanics go to endless trouble to ensure that there is a gear ratio available exactly to suit the long steep climb between the "XL Bend," up through the "Energol Cutting" to "Reid Park."

Once this happens, the idea of using the speedometer to judge engine speed is considerably complicated. It then becomes virtually essential to be able to measure engine speed directly, not only to avoid over-taxing the motor, but also to confirm that it is, in fact, developing maximum torque, horsepower, etc., under the particular conditions involved.

In watercraft, whether used competitively or not, some form of tachometer is highly desirable, since there is not even a speedometer to give an indication of engine speed. And, in competition, much the same problems apply as in car racing, except that gear and diff. ratios are replaced by propeller sizes, pitch and r.p.m.

A further application involves stationary engines of most kinds, since there usually is an optimum speed at which these should be run for best all round performance and efficiency. Once again, the problem of suitable gear ratios may have to be solved and a means of measuring engine speed is essential if this is to be done properly.

A somewhat different approach is to regard the tachometer as a piece of test equipment, along with gas analysers, dwell meters, and all the rest of the equipment needed to keep a modern engine in tip-top tune. In this regard it might be a separate instrument in its own right, or part of a more complex unit, such as a dynamometer.

TACHOMETER TYPES

Tachometers are in two main forms; mechanical and electronic.

The mechanical types usually operate on the same principle as the speedometer, differing only in the calibration and the fact that they pick up their drive from the engine rather than the road wheels.

The electronic types usually operate from the ignition system, using a circuit which counts the rate of ignition pulses and converts this to D.C. for application to a suitable calibrated meter.

Where the instrument is to be fitted as part of the original equipment, as in certain expensive sports car, the mechanical type probably has the advantage of simplicity and reasonable cost, together with the fact that it is a well tried and proven system.

However, in most other cases the electronic type wins hands down. A major advantage is that no mechanical take-off point is required; something which can be quite difficult and expensive to fit. Also, it may be located at virtually any distance from the engine and connected by a single pair of wires.

This is a particularly useful point in boats where the distance and positions involved may make a flexible drive shaft inconvenient or impracticable.

Similarly, in stationary plants it may be desirable to locate the dial on a remote control panel for ease of monitoring.

Electronic tachometers are not new. They have been used extensively throughout the motor trade as test instruments for many years, but it is only recently that circuits have become suf-

ficiently simplified to justify their use in the applications we have been discussing. Most of the older types used valves and conventional power supplies, making them rather bulky and complex for anything but garage use.

Others sought to simplify the circuit by using relays, but these were quite critical of adjustment in regard to spring tension, contact spacing, etc., and so cannot be considered by the home builder.

The advent of the transistor has changed the outlook considerably, making possible comparitively simple circuits which will work directly from the car battery, at least on 12-volt systems. Six-volt systems are a little harder, but the possibilities are reasonably bright.

BASIC OPERATION

Before considering the construction of such a unit, it might be worth while to discuss some of the theory of operation, particularly as this will be new to most of us. There is, in fact, more than one approach to the problem but the one we are about describe is a very popular one.

The pulses used are those appearing across the breaker points in the primary circuit of the ignition coil. While the points are closed this voltage is zero, rising to approximately the battery voltage when they are open, and dropping to zero again when they close. Thus they produce a roughly rectangular pulse for every firing stroke—at least in the ordinary four-cycle engine.

Now we must consider some way to count these pulses. Although an over-simplification of what goes on, it might help the beginner to grasp the idea if we imagine a frequency conscious meter fed with these pulses.

Such a meter might be simply one with a suitable capacitor in series with it so that it has a poor response to low frequencies and a good response to high frequencies. Then, as the motor speed ranges from slow to fast, the pointer will move up the scale and could be calibrated in terms of r.p.m.

However, such a scheme would not be very practical. For one thing, the meter would be amplitude conscious as well as frequency conscious, causing it to vary with the voltage of the electrical system, the condition of the break points, plus such variables as contact bounce at high speed, and so on.

One of the first jobs to be done, therefore, is to pass these pulses through some kind of limiting or clipping circuit so that they are clipped to a constant amplitude. That done, we may pass them on to our counting circuit.

WIDTH VARIES

Although we described this as a frequency conscious meter in the interests of simplicity, it is worthy of a more detailed explanation. Assuming a limiting device, we are left with a series of pulses of constant amplitude, but varying in width (with frequency) in direct proportion to the distance between them. In other words, their "mark/space ratio" is constant.

For this reason the energy content of a group of these pulses will be constant regardless of frequency. At low frequencies the pulses are large, but there are few of them; at high frequencies there are more pulses, but they are proportionately of shorter duration. Fed to a meter they will give a constant reading, just so long as the mechanical inertia of the meter is able to integrate them or add them.

This brings us to the next step, the treatment of the pulse to make them all of the same duration, regardless of their frequency. If we can do this, then the energy content will vary directly with frequency and our meter will read accordingly. Another way of looking at it is to say that the "mark/space ratio" is no longer constant, but varies with frequency.

We can make all our pulses have the same shape and duration by the process of differentiation—a subject already discussed in some detail in TV text books, including the current "Course in Television." (See "R., TV and H.," January, 1958.)

The simplest concept of a differentiation circuit is a capacitor and resistor in series. The signal (the rectangular pulses in this case) is applied right across the series combination, while the output is taken across the resistor only. If we select values of R and C to give a time constant which is short relative to the duration of the pulse, the output wave form will be completely different from the input.

Instead of a series of pulses, relatively broad, we now have a series of narrow spikes. There will be one of these at the commencement of every pulse, and having the same polarity, and another at the finish of the pulse, but having opposite polarity. If this second spike is not required, as in our case, it may be eliminated by means of a rectifier in some form.

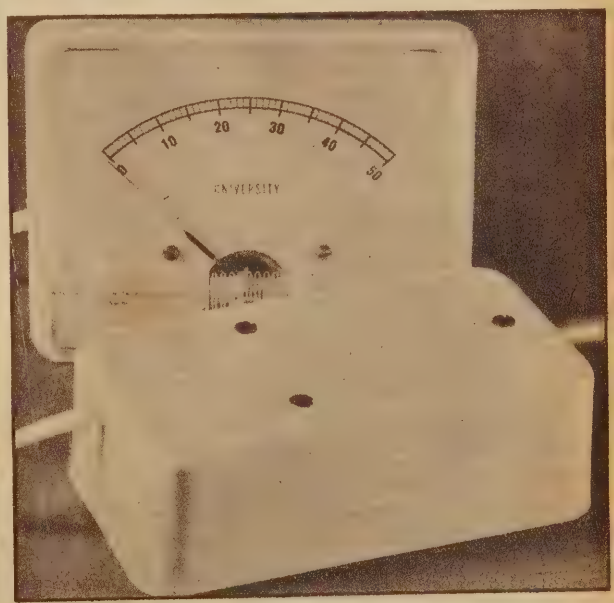
"FREQUENCY" METER

This leaves us with a set of uni-directional spikes, or short pulses, produced from the original longer pulses. The important point to grasp is that the shape and duration of these short pulses is quite independent of the longer pulses which produced them, being determined solely by the constants of the differentiating network.

Thus we are left with a series of constant amplitude, constant duration pulses, which vary only in their spacing, according to frequency. Fed to a meter, they will cause it to read directly in terms of frequency.

WHERE R.P.M. ARE ALL-IMPORTANT

Another use for the tachometer. Only by measuring engine speed directly can these drivers be sure they are getting the best possible performance from their cars. If "foreign" gear boxes and/or diffs. have been fitted, this instument is even more essential.



The finished tachometer, complete with meter. A wide variety of meters is available to suit individual requirements and match the existing instruments. The unit itself is housed in a small plastic case, and requiries only three connections to the motor.

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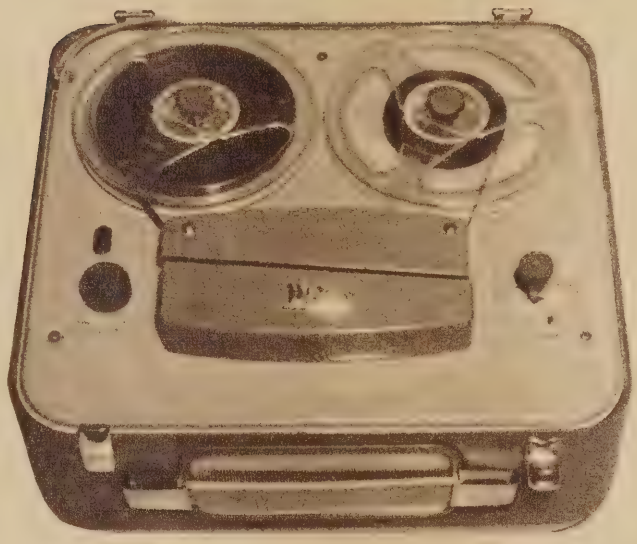

RUSH YOUR ORDER IN NOW TO AVOID DISAPPOINTMENT

NO OTHER TAPE RECORDER AT ANYWHERE NEAR THE PRICE OFFERS YOU THIS WONDERFUL SPECIFICATION

65 GNS.

HIGH QUALITY CRYSTAL MICROPHONE!

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RADIO/GRAM RECORDING LEAD AND PLUGS!

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- ★ Famous Walter all-in-one "joystick" control for Record/Playback and Fast Winding operations.
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- ★ 5in tape spools hold enough tape to play for two hours.
- ★ Attractive modern styling and beautiful 2-tone colour scheme.

MAINS VOLTAGE 6 OR 12 VOLTS	AC only 200/250 volts. 50 cycles per second. (through invertor).
CONSUMPTION	50 watts.
VALVES	Mullard Miniature.
DECK	WALTER MK. I.
HEAD	Twin track Micro Groove CCIR and Continental sensed.
REEL SIZE	5in.
TAPE SPEED	3¾in per second.
RECORDING AND PLAYBACK TIME	600ft Standard Tape — 1 hour — 30 mins. per track. 900ft Long Play Tape — 1½ hours — 45 mins. per track. 1200ft Double Play — 2 hours.
SPEAKER	High Flux 5in speaker.
OUTPUT	2 watts.
OVERALL FREQUENCY RESPONSE	60-7000 cycles per second.
OVERALL DIMENSIONS	11¾in x 11in x 6½in.
WEIGHT	17lbs.

From this basic theory let us turn to a practical circuit and see how these things are accomplished. The circuit we chose for our experiments is one issued by Standard Telephones and Cables, and was developed by them to suit locally available transistors. It appears to have a number of advantages over most other circuits we have seen described so far.

The first part of the circuit, between the breaker points connection and the TS14, is a resistance capacitance network forming a low pass filter. This has two functions; one is to eliminate spurious frequencies caused by contact bounce, oscillations in the ignition coil, etc., and the other to protect the TS14 from the high voltage spikes caused by the inductive nature of the ignition circuit. These latter may equal several hundred volts.

PULSES SHAPED

As a result, the very ragged pulse across the breaker points is rounded off considerably by the time it reaches the TS14. This stage is operated without any forward bias and draws no current in the absence of a signal.

The lack of forward bias causes the stage to rectify, since no collector current will flow until a pulse of correct polarity and amplitude is received. This is desirable because the pulses, although originally uni-directional, are virtually AC after passing through the coupling capacitor preceding the TS14.

Equally important is the ability of the stage to limit or clip the height of the pulses. The operating conditions are such that, above a few volts input, the TS14 commences to overload and any further increase in signal input produces virtually no change in output.

The operation of the TS14 is really that of a switch, since it has only two conditions of operation, "on" or "off." It is either not conducting at all during no signal conditions, or is conducting to a maximum degree during signal pulses. There is no intermediate condition. The output is a series of pulses, constant in amplitude, but still varying in width according to the frequency.

These are now coupled to the following stage, the 2N185, through the coupling capacitor "C," and some differentiation takes place in the process, even though this is not its main function. As a result, the signals fed to the base of the 2N185 consist of narrow triangular pulses of constant amplitude and nearly constant width.

SWITCH FUNCTION

As with the TS14, the 2N185 is intended to function as a switch and again this is achieved by severely overdriving it. However, due to the phase of the pulse delivered by the TS14 (positive going) the operating conditions are different. Since a positive pulse at the base will reduce collector current, this stage is operated with a relatively high standing current (around 60 mA) and the pulse drives it to the zero condition.

Once again there are only two conditions of operation, only this time they are reversed. Maximum current flows under no signal conditions and zero current when a pulse is received. The amplitude of the pulse is such that the stage is held at zero current for an appreciable period. Thus the output at the 2N185 collector is a series of rectangular pulses of constant amplitude and almost constant width.

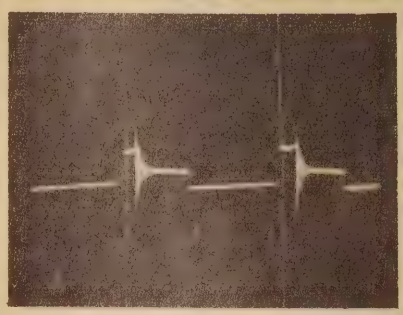
Use of the transistors in this manner renders them largely immune to temperature effects, and the designers claim a change of only 4 per cent over a temperature range of 25 to 60 degrees C. (77 to 140 degrees F.).

Finally we pass these pulses through the 1 mf capacitor preceding the rectifier network. This is a true differentiating circuit, and the output is a series of alternate positive and negative spikes in the classic pattern.

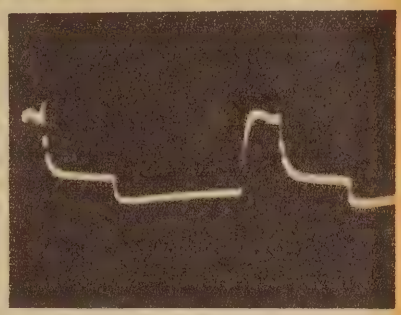
After passing through the rectifier, one spike is removed, and we are left with a series of uni-directional spikes suitable for application to the meter. These have a constant amplitude for all input pulses above a few volts and a constant width regardless of frequency. Thus the meter reading is directly proportional to the number of pulses in a given time.

As can be seen from the circuit, the device in its original form is intended for 12-volt operation, six-volt operation presenting a number of problems which we will discuss later. The polarity of the electrical system does not matter, i

WAVE FORMS FOR EACH STAGE

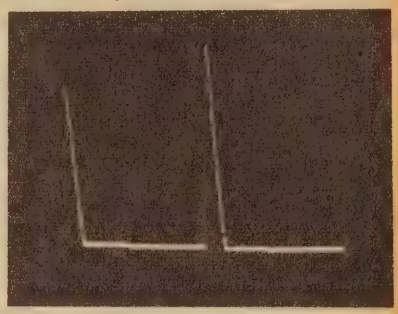


Waveform across the distributor contacts. Note the high voltage spikes which are longer than we can show here.

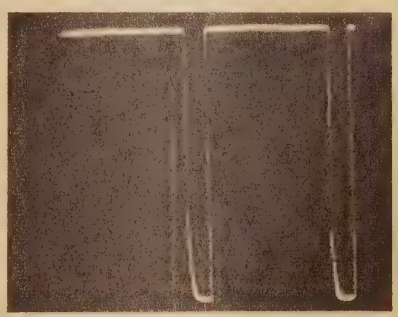


The same pulses at the TS14 base. The low pass filter has removed the high voltage spikes and spurious oscillations.

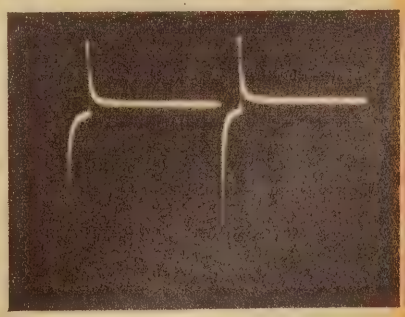
At the TS14 collector. The stage is severely overdriven, producing pronounced clipping which is clearly evident.



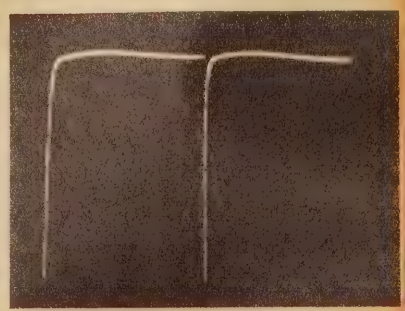
At the base of the 2N185. Some differentiation has taken place, resulting in short duration spikes of almost constant width.



At the 2N185 collector. Once again severe overload has clipped the pulses to ensure constant amplitude.



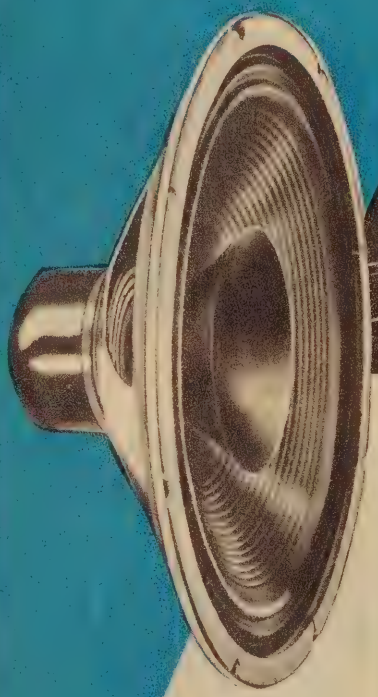
The same pulses after differentiation by the 1 mfd capacitor. Spikes have constant width regardless of frequency.

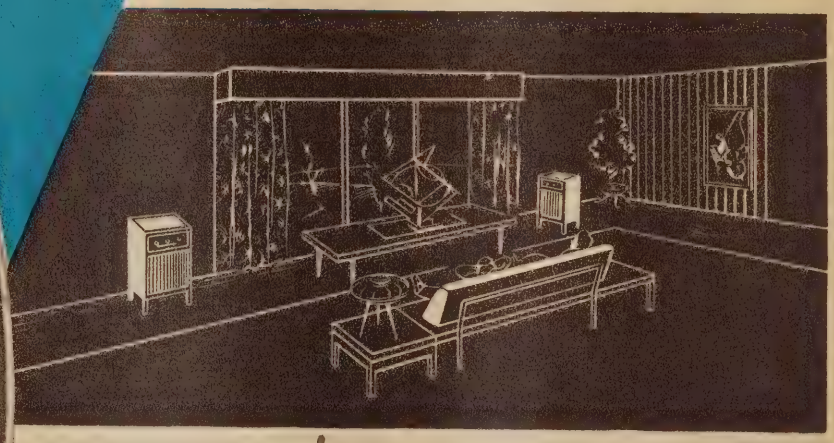


Across the meter without the bypass capacitor. These pulses deflect the meter directly in terms of frequency.

"lovely to listen to"

The New ROLA STEREO MASTER model 12 PX





Here is the loudspeaker for which you have been waiting, a true high fidelity loudspeaker at the price you want to pay. Yes, in every respect the new Rola STEREO MASTER 12PX is outstanding. It will handle a full 20 watts peak power with negligible distortion. It has a frequency response more than adequate for even the most tone conscious. Its 15 ohm voice coil will match standard hi-fi amplifiers. Further, its design is such that it will give good bass response when mounted in a conventional open back cabinet — a vented enclosure is not essential.

You'll really have to hear this new Rola loudspeaker to appreciate how good it really is.

You'll marvel at its fine *"bass"*, its smooth *"middle"* and clean *"top"* and at its overall liveliness due to its excellent transient response.

You'll want to own a Rola STEREO MASTER 12PX (two if you're a Stereo fan). It's the best medium priced wide-range loudspeaker ever developed and, speaking of price, *it's only £15/5/-.*

VENTED ENCLOSURES:

If you wish to mount your Stereomaster 12PX in a vented enclosure, write for our 8 page brochure giving full construction details.

SPECIFICATIONS

Power Handling Capacity	20 Watts Peak
Diaphragm:	
Fundamental Resonance	50 cps
Frequency Response	45 cps — 12 kc
Voice Coil Impedance	15 ohms at 400 cps
Air Gap Flux Density	12,800 Gausses
Total Gap Flux	87,000 Lines
Principal Dimensions:	
Overall Diameter of Diaphragm Housing	$12\frac{3}{32}$"
Diameter of Baffle Opening	$10\frac{29}{32}$"
Diameter of Voice Coil	$1\frac{3}{4}$"
Depth from Pad Ring to Rear	$4\frac{3}{4}$"

ROLA COMPANY (AUST.) PTY. LTD.

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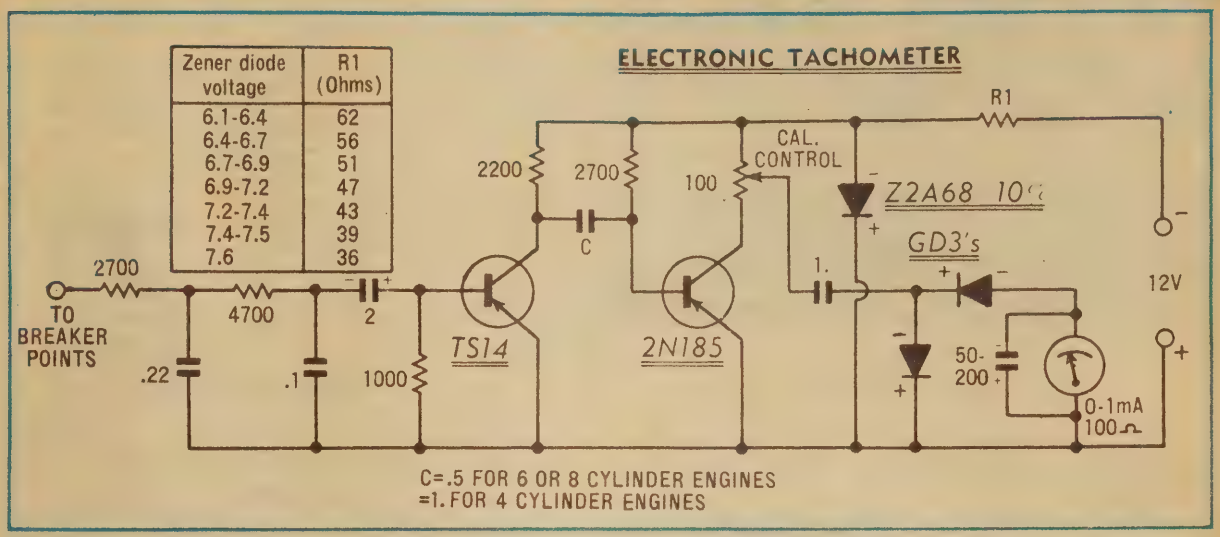
SIMPLE TACHOMETER CIRCUIT USES FEW PARTS



The circuit is very similar to the original published by Standard Telephones & Cables. The network on the left is the low pass filter to eliminate spurious frequencies. Both transistors function as switches and the differentiated pulses are fed to the meter on the right.

merely being necessary to observe correct polarity of power to the unit, regardless of which side happens to be earthed. The entire unit is kept insulated from the chassis of the vehicle.

The circuit is rendered relatively immune to changes in voltage from the car electrical systems by means of a zener diode voltage regulator circuit. This consists of the zener diode Z2A and a series resistor "R," the latter chosen according to the actual voltage at which each particular diode is found to operate. Since there are a number of points to be considered about this part of the circuit a fairly detailed discussion is warranted.

REGULATION CIRCUIT

The zener diode originally specified was a type Z2A68, the "68" indicating a nominal operating voltage of 6.8 volts. These devices are available in 5 per cent, 10 per cent and 20 per cent tolerances, using the same preferred values as used for resistors. The 5 per cent types are fairly expensive, the 10 per cent types are about half the price, and the 20 per cent types being slightly cheaper again.

The range of the 20 p.c. types is too broad for this application, while the 5 p.c. types are likely to be too expensive, leaving us with the 10 p.c. types as a natural choice. The voltage range covered by these is from 6.1 to 7.6 for the type 68.

This means that any particular type 68 diode you purchase may operate at a voltage somewhere between these limits. According to the actual voltage at which it does operate, a resistor must be selected to suit it, and a table is included in the circuit showing the values to be used over this range.

Note that in no circumstances must the diode be connected to the voltage source without sufficient protective resistance. If it should, it will be destroyed.

A new diode is best checked by connecting it into circuit with a 100 ohm variable resistor in series, set to its maximum value. Then, with an accurate voltmeter, measure the voltage developed across the diode as the resistance is reduced. At first the voltage will rise quite rapidly, then will suddenly "peg" at some particular voltage and rise only slightly as the resistance is further reduced. This voltage should be used to select the correct series resistor from the table.

Although the actual voltage at which a particular diode operates will not affect the accuracy, once the unit is calibrated, it does affect the overall sensitivity. Our experience suggests that, at the lower limit of 6.1 volts, there may not be enough sensitivity to give full-scale deflection on a 1 mA meter, when operating from a four cylinder car at 5,000 r.p.m.

Sensitivity can be increased in two ways; by using a more sensitive meter, such as a .5 mA type, or by increasing the differentiating capacitor from 1 mfd to 1.5 or even 2 mfd. A .5 mA meter will normally cost no more than a 1 mA type, but those who may want to use existing meters will be at a disadvantage. The only objection to the higher capacitance is the probable need to make this up from two units and the extra bulk of such an arrangement.

An alternative approach we considered was that of using the next higher zener diode in the 10 p.c. range; the type 82 with a range from 7.4 to 9.2 volts. This will provide ample sensitivity, but care must be taken to see that neither the diode nor the 2N185 is overrated.

DISSIPATION PROBLEMS

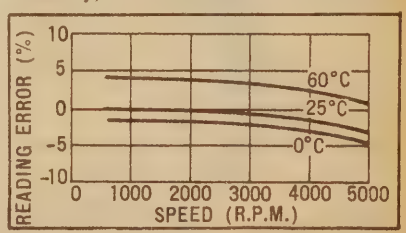
In regard to the diode, a combination of one operating at the upper limit (9.2 volts), an electrical system delivering around 15 volts, and an ambient temperature of 60 degrees C, may make it difficult to provide adequate regulation while keeping within the dissipation ratings.

In selecting operating conditions (i.e., a suitable series resistor) there are two limiting values which need to be observed. The minimum current recommended for satisfactory regulation is 20 mA, while the maximum current which the device can safely carry is 500 mA at 35 degrees C (95 degrees F).

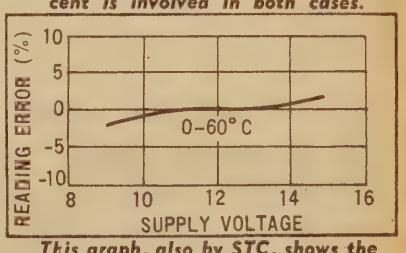
A resistor should therefore be selected which, at the lowest voltage likely to be encountered will allow not less than 20 mA to flow and, at the highest voltage, does not exceed the dissipation ratings of the diode.

This means a current of 500 mA at 35 degrees C, but it should be derated to about 370 mA at 60C (140F). This latter temperature figure is that suggested by the makers. It may seem high, but it is not an unreasonable one, considering some possible circumstances. It will be up to the individual to decide whether a lower figure can be accepted.

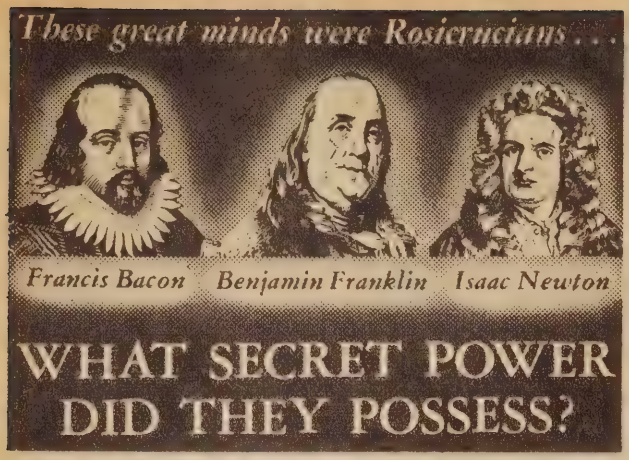
Ideally, the minimum current should



Another STC graph shows both departure from linearity and effect of temperature. Only a few per cent is involved in both cases.



This graph, also by STC, shows the effect of supply voltage variation. Over the range of a typical system it has little effect on performance.



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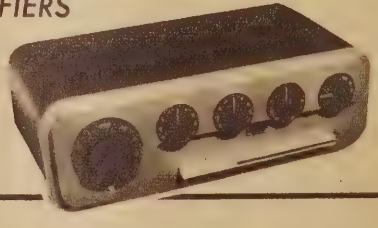

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be made as high as possible, consistent with safety at the other end of the scale, in order to provide the best regulation. In the case of the type 68 diode the minimum current is around 40 to 50 mA and a similar figure should be aimed at if possible. It would seem reasonable to regard the minimum voltage likely to be encountered as the nominal voltage of the battery.

We have been able to try only one of these type 82 diodes, and this appeared to work quite well. It operated around 8.4 volts, passed 40 mA minimum current with a series resistor of 27 ohms, and rose to 170 mA at 16 volts. This is well within ratings, but a diode which happened to be right on the upper limit of 9.2 volts may not be so attractive.

2N185 RATINGS

In regard to the 2N185, a combination of a 9.2 volt supply and high ambient temperature may cause a transgression of dissipation ratings when a pulse is received, even though the "no signal" operating conditions may be well within ratings. For this reason it would appear wise to increase the collector load resistor to 150 ohms.

We have made a few other minor changes to the circuit. The 10K resistor between the TS14 base and emitter has been reduced to 1K, a value which appears to improve linearity somewhat without any adverse effects.

We have also shown a capacitor across the meter, the main purpose being to minimise "pointer quiver" at certain points on the scale where the pulse frequency corresponds to the mechanical resonance of the meter movement. The value is not critical, but a minimum of 50 mfd is suggested. A rating of only a few volts will be adequate.

The next point to consider is the practical physical form such a device should take. Two possibilities present themselves; a unit which is intended for fitting to one particular motor or class of motor, or a "universal" instrument, in the form of a piece of test equipment, which may be used on virtually any motor.

For the moment we intend to discuss the first possibility. It is the simplest, and probably will have the widest appeal. Later we may consider the problems peculiar to a test instrument. Incidentally, some preliminary thoughts suggest that these may be more numerous than might at first be imagined.

STANDARD WIDTH

Apart from the meter, the whole unit is constructed on a piece of matrix board seven holes wide (a standard width) and 4½in (18 holes) long. In addition, you will require a packet of rivets and rivet type solder lugs to suit this board.

An excellent idea of the layout can be obtained from the photographs, and this follows the general disposition of parts in the circuit quite closely. The positive line runs along one side of the board (a bare tinned copper wire linking most of the lugs) and the negative supply line along the other side. This is shorter, extending over only three lugs.

The various components are strung across the board in roughly the same order as they appear in the circuit. The low pass filter is at one end preceding the TS14, followed by the 2N185, the zener diode, the differentiating capacitor, and the rectifier network.

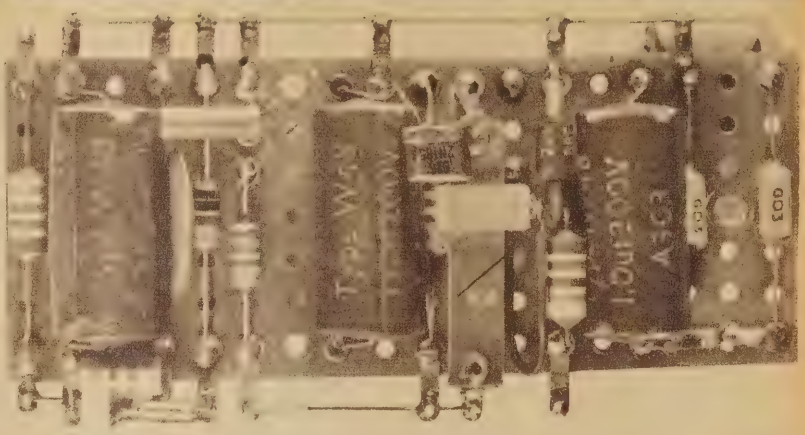
A few connections are made on the underside of the board and, in the photograph shown, an extra .5 mfd capacitor has been fitted in parallel with the 1 mfd differentiating capacitor above the board, to provide added sensitivity for reasons already discussed. However, in most cases this will not be necessary.

Apart from those components already dealt with, none is particularly critical. The resistors may be half watt types, while the calibration control is a simple 100 ohm wire wound slider pot. recently made available for use as a heater centre tap and similar applications. It is clearly visible in the photograph alongside the 2N185 transistor.

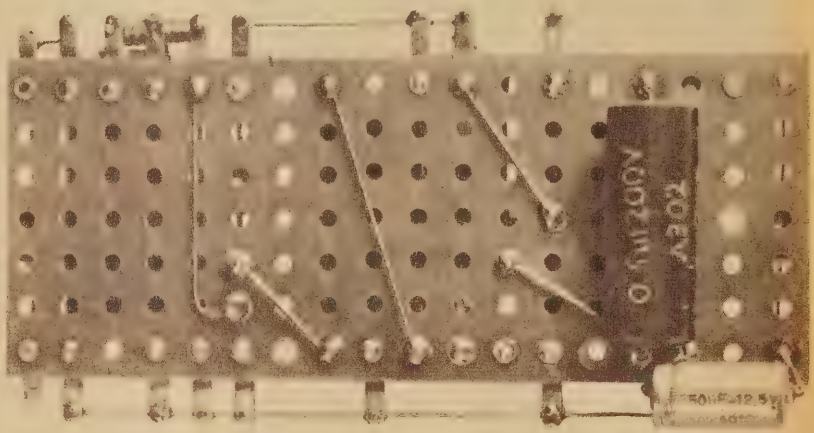
The capacitors should be metallised paper or low voltage paper types in most positions, although we used a ceramic Hi-K type for the .1 mfd in the low pass filter. Some of the voltage ratings visible in the photographs are higher than necessary, being the ones most conveniently to hand at the time. The 2 mfd unit immediately preceding the TS14 is an electrolytic.

The complete unit is housed in a small plastic case similar to that used for the TV Remote Control Unit last month and for several previous projects. It produces a neat compact unit which may be accommodated in almost any odd space in the vehicle.

ASSEMBLY AND WIRING DETAILS



All the components are readily visible in this picture. The low-pass filter is on the left, with the input terminal at top left. The bare copper wire at the top is the positive run, that at the bottom, the negative.



This picture shows the few connections on the underside. The .5mfd capacitor is an "extra" being in parallel with the 1mfd differentiating capacitor to provide increased sensitivity where needed.

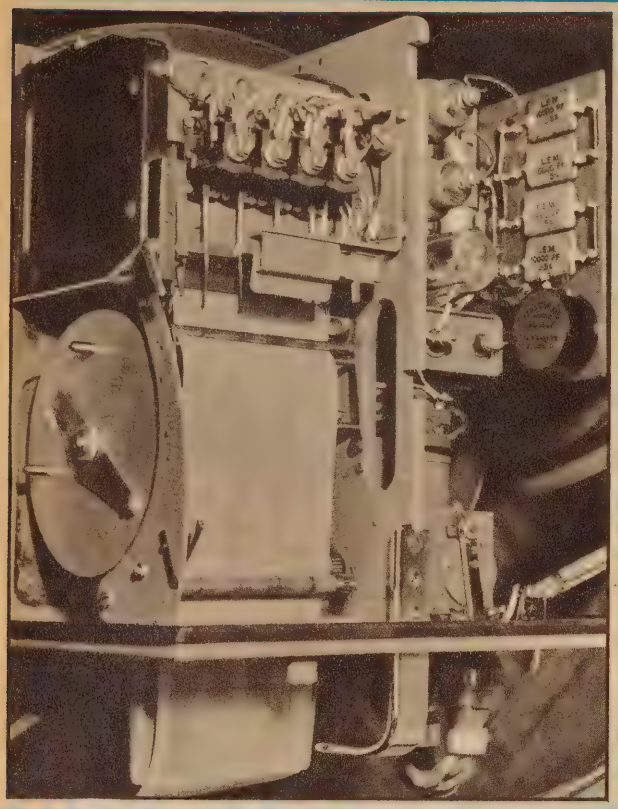
The board is supported by three 1/8in countersunk screws passing through the top of the case. The nuts which secure them on the underside should be fitted with shake proof washers of some kind, and this applies to all other similar mountings in the system. Otherwise, vibration will shake them loose in a few hundred miles.

SUPPORT POINTS

These screws pass through three unused holes in the board, one between the two GD3 rectifiers and two near the coupling capacitor between the TS14 and the 2N185. These holes may need to be enlarged slightly to take the screws, but should be kept a neat fit. There is not a great deal of clearance to the adjacent solder lugs, but it is adequate considering the low voltages involved.

The screws should be at least long enough (about 1¼in) to secure a cover of some kind on the box and this, in turn, should have facilities to mount it on the bulkhead or other convenient position. Alternatively, the screws may be long enough to serve directly as mounting supports, the unit mounting directly

(Continued on Page 123)



A typical fault recorder in use by the Electricity Commission of New South Wales is the four pen oscillograph at Homebush shown at left. The chart drive, pens, and oscillograph elements can be seen.

High Voltage Fault Recorders

For many years, recording instruments, which will start automatically when a fault occurs and provide a visual record of voltage and current conditions existing during the fault, have been considered of great value by major electricity supply authorities throughout the world. This article, which should be of interest to many readers, describes their function and operation.

By R. J. G. Watt*

MANY instruments have been developed, which have operated satisfactorily but with certain limitations, principally with respect to the time needed to start and the method used to provide a visual record.

Most of the recorders in use consist of a number of electro-magnetic oscillographs—sensitive moving coil galvanometers with some means of transferring the coil deflection to a chart.

The galvanometer coil is pivoted or suspended in a powerful field provided by a permanent magnet, and deflects to the left or right of a central position, depending on the polarity of the applied voltage and the type of movement.

This deflection may be transferred to a chart by a pen and ink system, or to some form of photographic film by a small light source.

TYPES OF RECORDER

Units employing the pen and ink method use a very small bore metal tube attached to the galvanometer coil.

Through one end of this tube, ink is siphoned from a reservoir and continues to flow by capillary action through the tube to the opposite end, which is so shaped as to form a pen. This traces on a paper chart a record of the galvanometer deflection.

Recorders of this type are relatively simple and robust, but suffer from the disadvantage that they are limited to accurate recording of alternating current quantities of frequencies up to a maximum of about 90 cycles per second.

The reason is that a pen of sufficient length to magnify the coil deflection to a readable value, because of its weight or mass, cannot respond fast enough to accurately reproduce the polarity reversals associated with frequencies greater than 90 cycles per second.

Instruments using photographic film or paper have a mirror attached to the moving coil, which can be made relatively small and with a very fine suspension system. A point source light is focused on to the mirror and reflected from it on to the photographic film.

BETTER FREQUENCY RESPONSE

Since a beam of light is used as the writing medium and the coil is usually of much lighter construction than that attached to a pen, the inertia of the movement is substantially reduced. Consequently an oscillograph of this type will accurately reproduce quantities with frequencies up to about 3,000 cycles per second.

An oscillograph of the latter type is more versatile in its application and more accurate than the former but is, in general, less robust and requires processing of the photographic chart before the recorded data is available for analysis.

Where recorders are used for providing information on system faults, it is desirable that the records obtained be available immediately after the fault.

In the opinion of the writer, the instrument employing the pen and ink system, in addition to being the cheaper of the two types, is the ideal unit for recording H.V. system faults.

In recorders of both types it is necessary for the chart to be driven at a speed which is determined by the frequency of the function to be recorded and the detail desired in the record.

SPEED OF PAPER

For example, if recording A.C. quantities with a frequency range of 45 to 55 cycles per second on a chart driven at a linear speed of 50 mm per second, at the mean frequency of 50 cycles per second, 1 cycle would occupy only 1 mm of chart length.

If the chart is driven at 200 mm per second, 1 cycle extends over 4 mm of chart and provides more detail of wave form distortion.

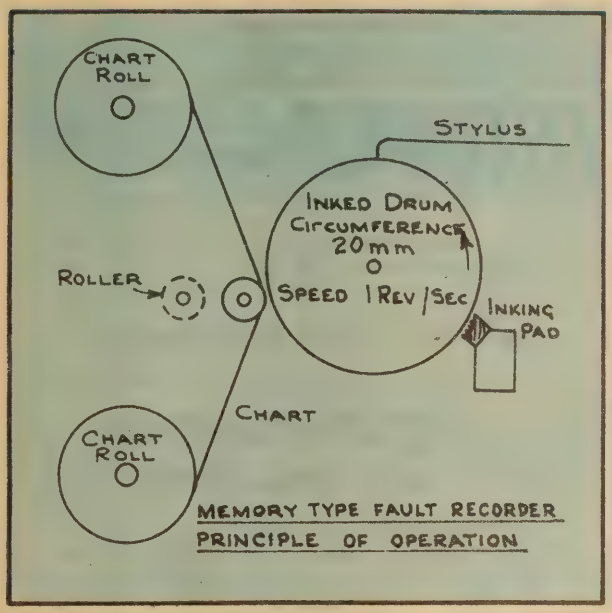
For the recording of faults on a H.V. system the quantities considered most desirable for analysis of the fault are phase currents, earth fault currents, phase to neutral voltages, system frequency, and the operation of automatic protection equipment.

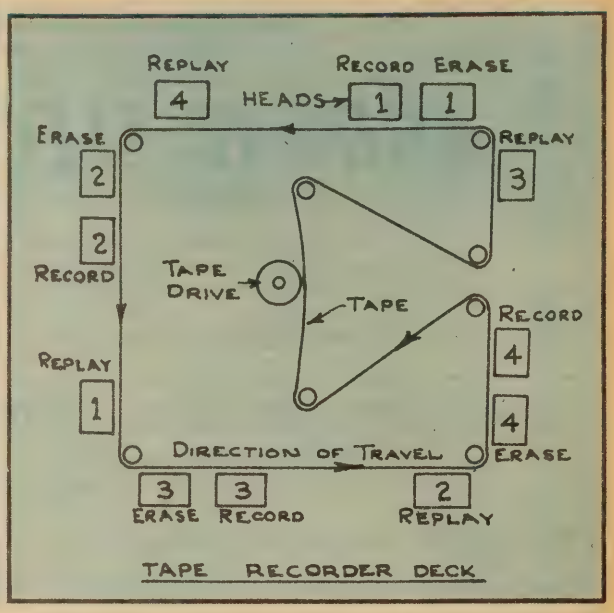
At a major substation such as Carlingford (N.S.W.), with eight 132 kV interconnectors and two—132 kV Busbar sections, recorders with a total of 32 channels are required.

In order to correlate the traces recorded, it is desirable for as many channels as possible to be on one recorder.

*Engineer/Protection and Communications Maintenance (Transmission Division) N.S.W. Electricity Commission.

HOW THE FAULT RECORDER "MEMORY" OPERATES





Illustrating two types of memory achieved (left) by an inked drum, as described in the text and (right) by means of a tape system. In the latter case, four channels have been assumed.

The 32 channels would be utilised as shown below.

	Channels
Red, Yellow and Blue phase currents on each 132 kV interconnector	24
Red, Yellow and Blue phase to neutral voltage on each 132 kV Bus Section	6
132 kV system frequency	1
132 kV Protection operation	1
TOTAL	32

Since the galvanometers are essentially voltage measuring devices, it is necessary to convert the currents in the H.V. current transformer secondary windings to voltages within the limits of the recorder elements.

This may be done by connecting potential dividers with suitable step-up transformers in the current transformer secondaries, taking into account the effect of the equipment inserted as against the C.T. rating and also the fact that the secondary currents possible under maximum fault conditions may be as much as 20 times the normal full load rating of the C.T.

POTENTIAL DIVIDERS

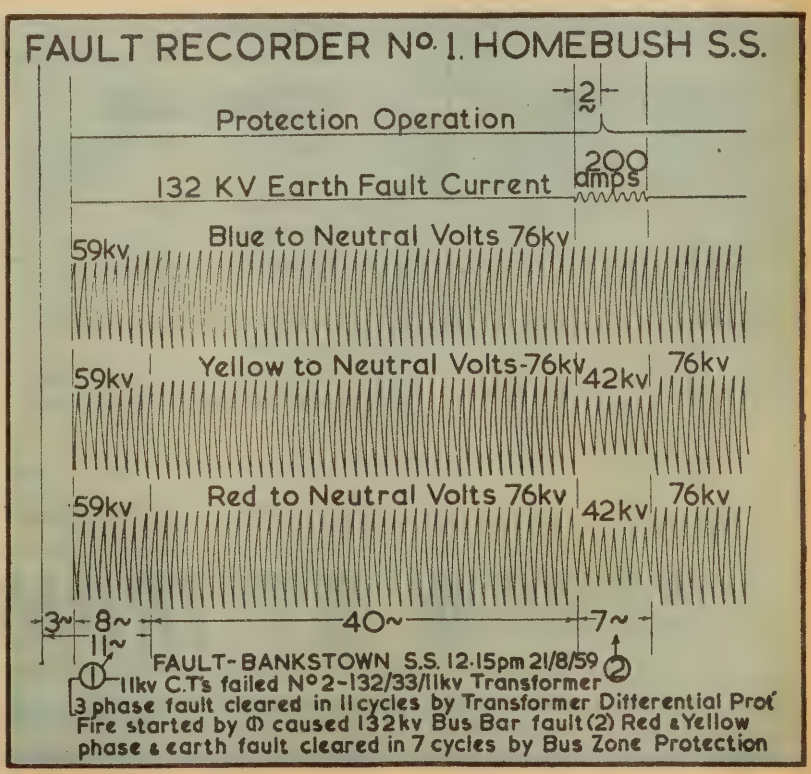
The phase to neutral voltages are obtained from the secondaries of voltage transformers connected to the H.V. lines or busbars and are usually reduced by means of potential dividers to meet the limits of the galvanometer coils.

A record of system frequency may be obtained by utilising a resistance — capacitance bridge network such as the "Wien" bridge, so adjusted that, at the normal frequency of 50 cycles, there is zero voltage across the galvanometer and the pen will trace a straight line.

Any deviation in frequency will produce a voltage across the galvanometer coil of either positive or negative polarity, depending on whether it is a rise or fall in frequency.

The deflection of the galvanometer is then proportional to the frequency variation.

Operation of protective relays on the H.V. equipment is indicated by a deflection of the respective galvanometer at the instant the relay contacts close to trip the respective circuit breaker.



Record of an actual substation fault which occurred recently. Such records are invaluable in taking steps to prevent their recurrence.

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Several methods are employed to "trigger" or start a fault recorder automatically on the occurrence of a fault on the H.V. system.

The one most commonly used is known as the "rate of change of voltage." This utilises the discharge time constant of a capacitor-resistance combination so arranged that a sudden fall in the 132 kV system voltage causes the capacitor to discharge and produce a voltage across the coil of a relay. This closes the chart drive circuit and connects potential to the galvanometers.

Normal or relatively slow falls in voltage due to load swings or system voltage regulation or rises in voltage will not cause operation of the triggering unit.

This method of starting has been used for several years and has proved extremely reliable, operating for faults and switching surges causing a sudden drop in voltage of 10 p.c. and over.

Other methods which may be used employ the contacts of overcurrent, earth-fault, over-voltage, or under-voltage relays connected in current or voltage transformer secondaries.

RECORDING DELAY

A major problem associated with fault recorders on H.V. networks is the delay in starting the recorder, which involves the application of potential to the recorder elements and bringing the chart up to speed.

For various reasons it is undesirable to have A.C. potential continuously applied to the galvanometer elements and it is impractical to run the recorder chart continuously at the desired recording speed of 200 mm (8 inches) per second.

High-speed relays are employed to apply the A.C. voltages to the recorder elements and fast action clutches or drives are used to bring the chart up to speed when the recorder triggering device operates.

The delay in bringing the recorder into action is in the order of three cycles (0.06 seconds) and consequently the record of the first three cycles of the fault are lost.

This has become a matter of greater significance with the introduction of high-speed protection on H.V. systems of 132 kV and above.

Many of these protective relays have operating times of 1 cycle (0.02 secs.) and the H.V. circuit breakers will trip in 3 to 5 cycles (0.06 to 0.1 sec)., thus giving a total fault clearance time of 4 to 6 cycles (0.08 to 0.12 secs.).

It will, therefore, be apparent that, in some instances, only 1 cycle of the fault conditions will be recorded.

Numerous attempts have been made to provide a recorder with a memory feature such that when triggered it will provide a record of conditions before, as well as during and after the fault.

It is believed that up to the present only one instrument has been developed which possesses all these features.

This particular unit has solid pens or stylii attached to the galvanometer coil and these stylii mark continuously on a rotating inked drum, leaving a clear track through the ink film.

These clear traces are erased every complete revolution of the inked drum.

On the occurrence of a fault, a moving paper chart is brought into contact with the inked drum at a point on the circumference approximately 120 degrees after the stylii marking point, thus providing a "memory" of approximately 0.3 secs. duration of conditions prior to the fault.

A timing relay is incorporated in this and other fault recorders to ensure that the recorder continues to run for a period longer than any fault is estimated to persist.

Thus, in this particular recorder, a complete continuous record is obtained of conditions prior to, during and after the fault.

BRISBANE FM SERVICE

In our December issue, we gave a frequency of 91.1 Mc. for the experimental frequency modulated transmitter operated in Brisbane by the Postmaster-General's Department.

A letter from Mr J. M. Bolton, Assistant Director (Engineering) advises that the frequency was altered recently to 94.1 Mc. to meet requirements of the Australian Broadcasting Control Board.

Readers may care to make the appropriate alterations on page 87 of their December issues.

The chart from the above recorder appears as a dark background of ink with partially clear lines representing the functions recorded. This arrangement, with such a large area of chart covered by ink makes it difficult to handle and analyse the chart record until sufficient time has elapsed to permit the ink to dry.

It is the writer's opinion that a form of tape recorder is the ideal medium for providing a fault recorder with a memory feature and the method is currently being investigated by the N.S.W. Electricity Commission.

There is every indication that the principle is successful.

The arrangement is such that a record, replay and erase head is provided for each channel on one or more continuously driven magnetic tapes, depending on the number of channels required.

INFORMATION USED

The A.C. and D.C. quantities to be recorded are fed to the recording heads and are continuously recorded and erased from the tape.

On the occurence of a fault, the replay heads, which are positioned between the record and erase heads, are brought into operation and transfer the information recorded to a pen recorder via amplifiers.

Four multi-channel fault recording systems are currently in use by the N.S.W. Electricity Commission, monitoring high voltage lines and more are on order. They variously use light source and pen systems.

The chart marked "Recorder No. 1, Homebush Substation," is a record of 132 kV phase to neutral voltages and earth fault current at Homebush Substation on the occasion of a fault at Bankstown substation on the 21st of August, 1959.

From the chart we can determine that the fault on the 11 kV current transformers was cleared in a total time of 11 cycles (0.22 secs.) allowing 3 cycles for the recorder start, and during this period the 132 kV phase to neutral voltage at Homebush dropped from a normal 76 kV to 59 kV on all three phases.

After the fault cleared the 132 kV voltage recovered to its normal value for a period of 40 cycles (0.8 sec.), during which time the fire below the 132 kV busbar was developing.

QUICKLY CLEARED

At the end of 40 cycles the fire caused a flash over on the 132 kV busbar on Blue and Yellow phases only, since these are the only phases in which the voltage is depressed to 42 kV. The fault was cleared in 7 cycles (0.14 sec.) by the 132 kV bus zone protection and since the recorder had not completed its pre-set running time a full record of the fault was obtained.

The foregoing will serve to indicate the value of system fault recorders which can save considerable time in the location of a fault on a transmission line and reduce the time of any interruption to supply.

Furthermore, the magnitude of fault current, type of fault, effect on system voltage and frequency as indicated in the chart, provide valuable data in assessing the performance of an H.V. system under severe fault conditions.

In addition, the trace indicating the operation of protection which has been superimposed for the purpose of this article, is visible proof of the performance of protection equipment.

In the case of the particular fault, the bus zone protective relay closed its contacts approximately 2¼ cycles after the fault occurred, and, since the total fault clearance time was seven cycles, the circuit breaker contacts took 4¼ cycles to open.

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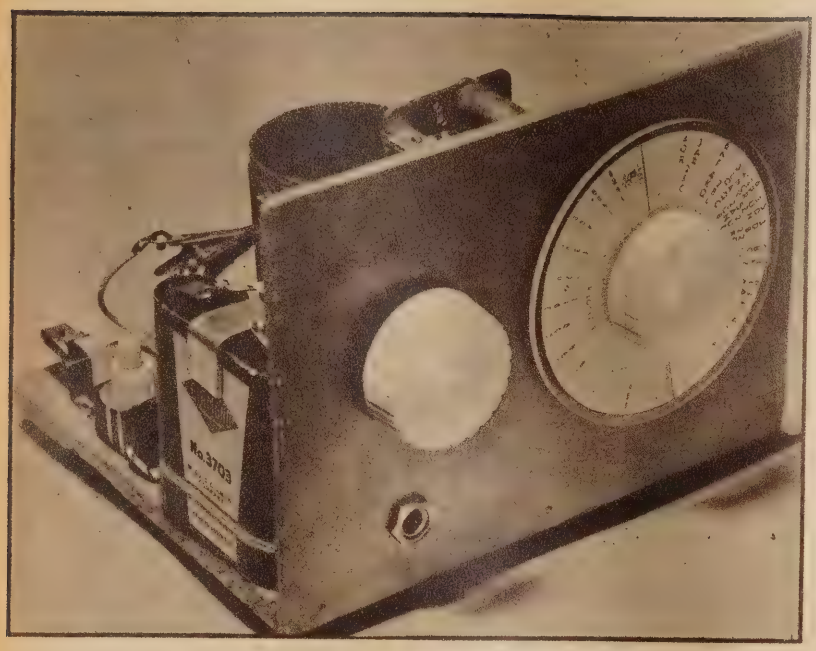


Our latest one-transistor receiver. Tuning is to the right, reaction control to the left. The phone jack is beneath the reaction control. The battery switch is just behind the battery but it could equally well be on the panel.

A One-Transistor Set For Beginners

Possibly you have already built a crystal set, or perhaps you are just contemplating building up some very elementary receiver as an introduction to the art. In any case you should be interested in our new little one transistor model.

THOUGH just a little "breadboard" job, it is much more sensitive than the average crystal set, and yet is fairly simple and still relatively inexpensive.

But there is more to it than that. Since transistors are finding ever-increasing application in the electronic world, it is important that the beginner becomes acquainted with their use as soon as possible.

This set offers an ideal introduction.

The idea of regenerative transistor sets is by no means new, several of them having been described in past issues. However, they have usually been embellished by other modern techniques, such as coils wound on ferrite rods or toroidal cores.

SIMPLE APPROACH

However, while these various schemes have been proposed for a definite reason and likewise have definite advantages, they have also deterred some prospective beginners by their sheer strangeness. In short, there is a demand for something which preserves the familiar cardboard former and the techniques of the classic crystal set.

In fact, if you already have a crystal set it should be quite an easy matter to convert it to this present circuit.

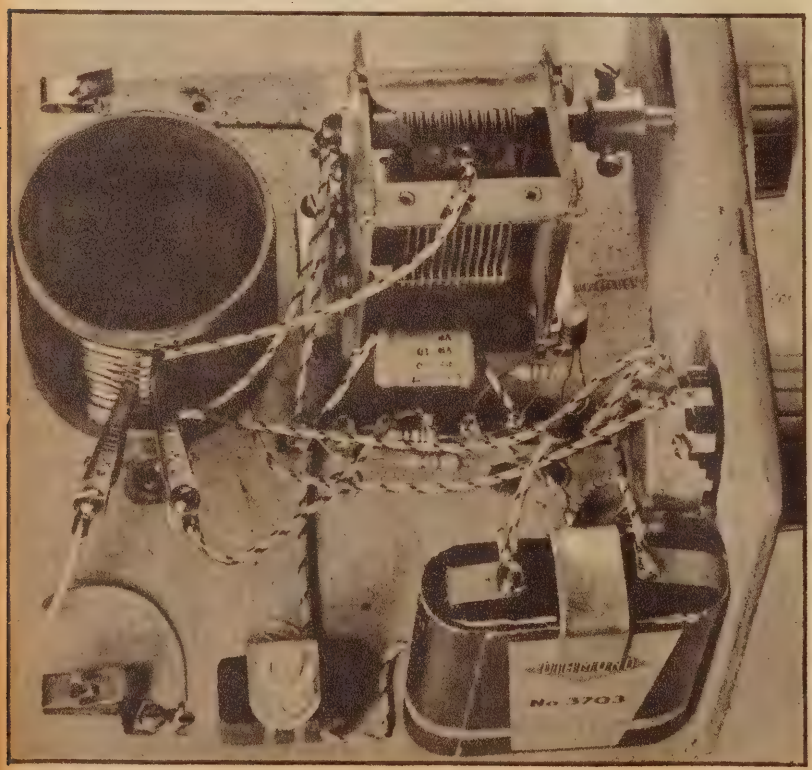
You will have the necessary tuning gang and coil and the headphones, and all that is required will be a few resistors and capacitors, a few extra feet of coil winding wire, the transistor and a battery.

Even if you have never built a set before this receiver is only slightly more complicated than a crystal receiver and the superior results definitely make the extra trouble worth while. You won't have to battle anything like as hard to bring in and separate the local stations while, under good conditions, you may even log much more distant ones.

CRYSTAL SET

In a standard crystal set, the crystal diode (or detector) extracts the audio signal from the radio wave which is intercepted by the crystal and passes it on to the phones. There is no amplification of either the radio wave or the detected audio signal. Therefore, the volume in the headphones is always limited by the strength of signal reaching the aerial.

This is a major drawback of all crystal receivers. In anything but very strong



This back view shows clearly our layout, which need not be followed closely, however. The earth and aerial terminals are Fahenstock clips from a discarded battery. They are ideal for "breadboard" construction. The battery is held in place by a piece of aluminium strip appropriately bent.

signal areas, one needs a substantial aerial and an earth as well. The provision of either or both can be a nuisance.

Again, if one lives closer to some stations than to others, the stronger stations tend to swamp out the weaker ones, making it necessary to fiddle with tappings on the coil, etc., to have any chance of hearing them at all.

The transistor, when connected in the manner shown in the circuit, acts as a combined detector and amplifier with the added feature of providing regeneration to overcome losses in the input circuit. The complete operation may be broken down into three stages, which can be described separately.

Firstly, however, it would be wise to familiarise yourself with the standard symbol for a transistor, shown in the accompanying diagram.

In some respects, a transistor may be compared with a triode valve, the symbol for which appears alongside. The emitter can be likened to the filament or cathode the base to the control grid and the collector to the plate.

VITAL DIFFERENCES

However, while the comparison is helpful in a way, it can only be carried so far, because there are vital differences in the whole behaviour of transistors and valves.

If a small signal is applied to the grid of a valve, it appears at the plate in an amplified form. Similarly, a small signal applied to the base of the transistor is amplified and appears at the collector.

There is a fundamental difference, however. Whereas the signal at the plate of the valve depends on the voltage at the grid, the signal at the collector of the transistor depends on the CURRENT in the base circuit. It is common to speak of the "current gain" of a transistor and, in general, the associated circuitry is of relatively low impedance.

With a valve circuit, the grid is normally connected right across the tuning circuit, to take advantage of the full signal voltage developed. In the case of a transistor, with its low input impedance, the base is normally tapped across only portion of the winding.

In this respect, it resembles common practice with crystal detectors.

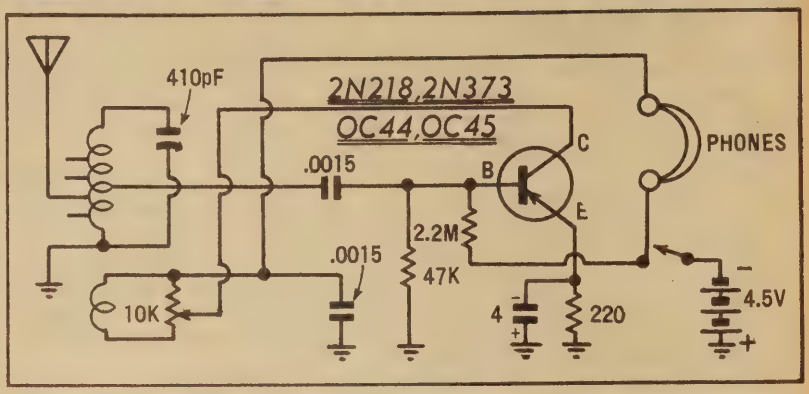
LOW POWER REQUIREMENTS

The advantage of a transistor is that it has no filament to heat and therefore requires no filament battery; it is physically very much smaller and it works well with a very limited "high tension" voltage. Our circuit needs only one 4½ volt battery and the total drain is no more than 100 microamps, or one tenth of a milliamp.

Since only a brief description of the manner of operation of the circuit is possible here, readers are referred to several back issuses of R. TV and H. where these and similar circuits are discussed in detail. For instance, the June, 1957 and December, 1958 issues could well be turned up.

The base and emitter of the transistor between them form a diode, as do the grid and cathode of the triode, which behaves in much the same manner as the crystal in a crystal receiver. In this case the "detected" audio signal appears across the base resistor, the 0.047 uF.

CIRCUIT FOR TRANSISTOR SET



There is a fairly wide choice of transistor types. Those marked on the circuit are only representitive, though the OC44 will give the higher gain. Any PNP transistor designed for RF or IF service should work, though some may not oscillate too readily at the high frequency end of the band.

in the circuit, instead of across the headphones as in a crystal set.

This small audio signal, together with the smaller residual RF, is amplified and appears at the collector across the audio load which is now formed by the headphones. The small capacitor across the phones reduces the residual RF even further, so that only the audio component remains in any quantity.

Since the transistor provides gain between its base and collector circuits, the signals heard in the phones are amplified in this proportion.

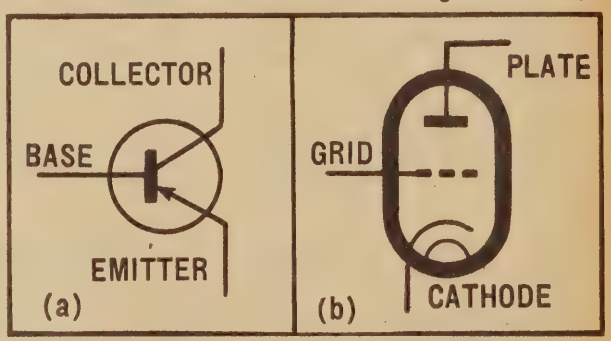
But that is not the end of the story.

It will be noted that there is a winding on the coil connected between the collector and the phones. It has only a few turns, so it offers no significant impedance to the audio frequencies. However, an appreciable RF voltage is built up across it. It is normally wound quite close to the main tuning coil, sometimes even over the bottom few turns.

☆

The symbol of the transistor is to the left and of the triode valve to the right. To some extent the transistor is similar in operation.

☆



RF voltage and current in this coil induces a similar voltage and current in the main tuning coil, which is duly amplified and fed back again, in a continuous process. If the "feedback" or "reaction" coil is connected the right way round, energy fed back will add to the original signal energy, producing what we call "regeneration" or "reaction."

The feedback can be varied so that a greater or smaller voltage is fed back to the input. With just sufficient feedback, the losses in the input circuit can be minimised, so the overall gains is greatly improved.

With too much energy fed back, the circuit "oscillates." By this we mean that the circuit feeds enough energy from output back to input to provide its own "signal." In fact, it becomes a generator of RF energy.

In the normal way it is undesirable for a detector to be left in a state of oscillation. Firstly, the signal which it sustains in the tuning circuit heterodynes or beats with any incoming signals to produce a whistle in the phones.

Secondly, there is a strong chance that some of the energy will be radiated from the aerial and cause interference in neighbouring radio receivers.

EFFECT OF FEEDBACK

By judiously applying feedback to a point where the circuit is just about to break into oscillation, the selectivity and sensitivity may be improved immensely, without these undesirable effects. The gain or amplification possible is far greater than with a transistor (or valve) without regeneration.

The 0.047 and 2.2 meg. resistors across the battery supply together form a voltage divider which, with the emitter resistor, sets the bias on the transistor.

As with a valve, the transistor needs to be biased so that it will operate to best advantage as a detector, or as an amplifier, as the case may be.

Here, we are trying to use the transistor both to rectify and amplify as much as possible, so that a deliberate compromise is necessary. However, it works out very well with the values quoted.

The actual construction of the receiver should offer no special problems since neither the layout nor the choice of components is at all critical.

The tuning gang can be any type with a maximum capacitance of about 400pF

O/B TELEVISION VANS FOR ADELAIDE

TWO air-conditioned Outside Broadcast Units supplied by E.M.I. Electronics Ltd. to the Australian Broadcasting Commission should shortly be in service in Adelaide.

The vehicles, which will use three of the latest E.M.I. Image Orthicon Cameras Type 203, will provide complete mobile studio facilities for the A.B.C.'s television outside broadcasts. These new cameras are designed to provide extremely stable signal output and thus ease the operator's task. They can be fitted with either 3in or 4½in Image Orthicon pick-up tubes, and in this instance use 4½in tubes.

The lens turret has five positions — most earlier type cameras only had four—one of which can mount a diascope or an additional lens, depending on operating requirements, on a removable panel which allows the quick replacement of the pick-up tube without opening the body of the camera itself.

The use of plug-in printed circuit boards makes for rapid maintenance, so the full complement of cameras can be kept in service throughout a broadcast and there is no need to carry spare cameras as a precaution against breakdown.

SELF-CONTAINED

Basically, the vehicles are divided into three areas — production area and control position, equipment compartment, and driver's cab. Intercommunicatoin between these areas is afforded by a corridor along one side of the unit, at the end of which is a pull-down ladder for easy access from inside to the roof.

A trailer houses a motor generator which supplies all the power required, so the unit is completely self-contained in the field.

The production area, which houses the vision and sound-mixing equipment, is air-conditioned by two 7,000 b.t.u. units, and the side windows provided with an improved type of sliding solid blackout panels.

The control position occupies the forward end of the production area, and operators of the cameras' electrical controls sit on a bench seat immediately in front of the production desk. From this position they can easily view the picture and waveform monitors.

Bevond the control position is a partition with door which extends across the unit to insulate the production area from heat, and possible noise, from the main equipment.

The equipment compartment is forward of the control position and contains the equipment associated with camera channels such as voltage regulators. This compartment is fully ventilated by extractor fans which draw air at ambient temperature through suitably protected vents in the floor.

(or .0004 mfd). It can be a single unit or part of an old ganged capacitor that you have acquired from somewhere.

Similarly, the dial can be anything that will operate the capacitor and allow you to find the stations when you want them.

If it should happen that you have a capacitor with a dial calibrated with station names to suit, then a little more care will be necessary to make the markings mean something.

In such a case, you will need to connect a standard variable trimmer across the tuning capacitor — something around the 35 pF. mark. The idea is to vary the number of turns on the coil till a station at the low frequency end of the band comes in at the right position on the dial. Then the trimmer is adjusted to bring the high frequency stations into line.

PROPER COVERAGE

Where the dial is not calibrated, you will not need to bother about this. Your main concern will be to see that the stations you want to hear all fall within the normal tuning range of the capacitor.

The coil may be wound on any former from about an inch to two and a quarter inches in diameter. The number of turns will vary with the diameter.

Assuming 24 B and S gauge wire the following combinations will be a guide:

DIAMETER	LENGTH	TURNS
1in	5.5in	250
1½in	2.75in	130
2in	1.9in	90
2½in	1.6in	75

These figures all assume a capacitor with a maximum value of about 400pF.

Of the figures quoted the 2in diameter coil would represent a good compromise between overall dimensions, shape and efficiency. Therefore, we suggest this size if you are setting out to buy a piece of coil former.

However, satisfactory coils can be made with much more humble materials than low-loss coil former. For example, you may be able to wind one on the cardboard centre of a paper towel roll, which has a diameter of about 1½in.

The taps are best made by laying a match along the former. Every seventh or eighth turn is wound over the match and all the rest under it. If you make these taps all the way along the coil, the most efficient point for connection of the aerial and the transistor may easily be found.

FEEDBACK WINDING

The feedback winding is wound about 1/16in from the bottom, or earthy end, of the main coil. It requires about 13 turns of the same gauge wire and is conventionally wound in the same direction as the tuned winding.

The amount of feedback is controlled, in this circuit, by the variable resistance which is shunted across the feedback winding. The full 10,000 ohms is connected across the coil and one end is effectively grounded by the 0.0015mF. capacitor across the phones.

When the sliding arm of the variable resistance is at this "earthy" end, all the RF available at the collector is shorted to ground and there is no feedback.

At the other end there will be the full 10,000 ohms between it and ground so most of the RF goes through the coil and feedback is maximum.

At some point between the set will be just on the verge of oscillating. It is in this condition that the control must be set for maximum efficiency. Of course, this exact point will vary with different stations and different signal strengths.

The length of aerial you will need will vary with the location. In the inner suburbs of Sydney for instance, about eight or nine yards of wire hooked around the curtain rails proves adequate for comfortable listening. If it is convenient to run an earth wire it will improve the reception and possibly less aerial will be needed.

We made our set on a wooden base board measuring 7in x 6in with a front panel of three ply measuring 5in x 7in. The general layout can be seen clearly in the photographs. It is definitely not critical. All the small components are mounted on an eight tag, tag strip near the tuning capacitor.

The transistor is best left with full-length leads. Transistors in general are sensitive to heat, so some care is necessary when soldering them. In this case, solder the transistor in last of all and hold each lead as it is soldered with a pair of pliers, to prevent too much heat from reaching it till the joint is cool.

Wire the circuit, check it carefully, then switch on. Transistors react very unfavourably to reversed battery polarity so make quite sure that is right.

SELECTING TAPS

Set the aerial clip near the top of the coil and the base lead near the middle and vary the reaction control. At one end of its travel the set will be fairly quiet. As you turn from this end towards the other you should reach some point where the set will break into a raucous, distorted whistle. The circuit is now oscillating.

This point may be more obvious if a station is tuned in first. If the set doesn't oscillate reverse the connections to the feedback coil and try again.

The technique of tuning reaction sets will be perfected with a bit of practice. The best way is to select the required station then rock the tuning control about this point, while at the same time advancing the reaction control to a point where it is just about to oscillate.

The best position for the aerial and base taps will vary with the length of aerial and the coil dimensions. Also different stations may require different settings for best results. However, unless you want to keep moving the taps about, it is best to settle on compromise positions which allow all stations to be received well enough.

PARTS LIST

1 Tuning capacitor (perhaps one section of a gang). About 400 pF max.
1 Coil former, from 1-inch to about 2½in diam. (See text)
24 B & S enamelled wire (about 16yds.)
1 Transistor, see circuit.
1 Potentiometer, 10,000 ohms.
1 Phone jack and high resistance phones.
1-2 megohm resistor, 1-0.047 megohm resistor, 1-220 ohm resistor, all ½ watt.
2 - 0.0015 mfd. capacitors.
1 - 4½ volt battery.
Miniature switch, tag strip, 2 knobs, dial, hook up wire, terminals, etc.

FILTER STOPS AMPLIFIER "PLOPS"

There are few things more unnerving than the shattering "PLOP" which a switching transient can produce from a lusty amplifier system. You can save your nerves with this simple home-made line filter.

The completed filter. On test, it eliminated "plops" which had previously worried two members of our technical staff, both using high-powered amplifiers

MOST amplifier enthusiasts are familiar with the situation. Attention is focused on the music; no other sound is heard in the room. The level drops to pianissimo; there's an air of suspense . . . then . . .

PLOP!

Twenty watts of it, booming out the cones and through the vents.

The assembled company "takes off" vertically, then settles back uneasily as

An inside view of the filter. The circuit and layout is simple but care must be exercised to make the unit safe from accidental shock.

the owner explains, limply, "It was just the frig. switching off. . . ."

Refrigerators don't have to make this noise but so many of them seem to do so. It can be stopped, so they say, by connecting a capacitor internally across the cutout but not everybody relishes the idea of fiddling around with such an expensive item of home furniture.

Besides which, refrigerators are not the only offenders, when it comes to line impulses. Light and power switches, electric irons, hot water systems, and so on, are all possible sources of annoyance.

And then the amplifier itself can produce its quota. One favourite trick is a very loud "plop" at the moment of switch-off or when the gramo motor switch is operated.

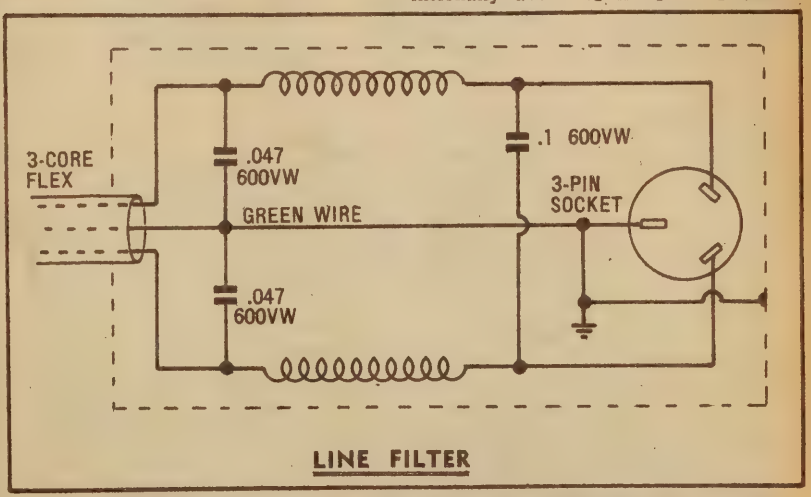
LINE FILTER?

In all such cases, there is a strong possibiilty that the noise problem can be abated by the use of an inexpensive line filter.

Line filters can be used in two ways—either to stop the noise at its source or to prevent it reaching the amplifier equipment.

Where the problem is RF interference, causing noise in radio channels, it is usually necessary to adopt the former approach, with the idea of preventing the noise from getting into the electrical wiring and being radiated therefrom into the aerial.

In the case of audio equipment, it is often more satisfactory to use the filter in conjunction with the amplifier, plugging it into the filter and the filter into the power point. This will usually reduce line pulses to an unimportant level and also prevent the amplifier or motor from making its own loud "plop" when switched off.



The circuit is quite standard for units of this type. Note that the incoming leads are bypassed to the wiring earth but the appliance end has just one capacitor straight across the supply.

To be effective for the purpose, a line filter should contain inductance in series with the mains leads and capacitance across them and to earth. Neither quantity is particularly critical but a certain order of both "L" and "C" is desirable to ensure adequate filtering.

Since the coils must carry the load current of whatever device is being filtered, they must not have too much resistance and must be mounted in such a way that there is no danger of a short across any portion of the circuit. Similarly the capacitors must be capable of withstanding the full mains voltage.

And, more important even than these points is the necessity for making quite certain that no person handling the filter can receive a shock. All these points have been taken care of in the filter pictured here.

It is built into the same handy little plastic box which we have used on a number of occasions recently, measuring internally about 4½ x 2½ x 1¾ inches. The box is readily obtainable through trade houses and can be had complete with a plastic cover.

If a cover is not immediately available, one can be fashioned from a scrap of bakelite, hardboard or plywood.

Heart of the filter is the coils. These were wound on ¾-inch outside diameter bakelised paper tube in our prototype, but wooden dowel or plastic rod could be used equally well. They should just slide into the 4½-inch dimension as shown in the photograph.

To anchor the wire, we attached a

(Continued on Page 128)

Figure 1:—Complete 40 watt supply is 6in by 3½in by 2½in overall. It delivers 400 volts at 100 mA. and is silent and efficient.

Modified Transistor DC-DC Power Supply

By JOHN BARKER

Further development in the design of the transformer has now made possible higher output from the supply described in September last, also intermediate voltages.

THIS converter is designed to replace less efficient and reliable vibrator power supplies and more costly genemotors in installations requiring up to 400 volts at 100mA. It gives better efficiency, longer life and lower noise level, both in the mechanical and electrical sense.

The previous version, due to the limitations of the transformer, could only supply about 80mA at 300 volts in some cases. It was a developmental model and was, as much as anything, an introduction to a new subject. Since then the manufacturers, R. W. Steane and Co. ("Q-Plus"), have released this new transformer which shows much better figures.

IMPROVEMENTS IN DESIGN

Improvements in the design of the transformer allow a full 40 watts of DC power to be drawn from the AC-DC converter, as previously described in full in the September, 1959, issue.

The new transformer employs a standard ferrite EHT transformer core, as used in television receivers. The coils are wound on a separate bobbin for ease of construction. There are three taps on the secondary, giving outputs of 200, 300 and 400 volts. The maximum efficiency point occurs at about 42 watts.

A discussion of the theory of operation of the converter will be of interest to new readers and those who missed the previous article.

Basically, its action is very similar to that of a vibrator, the circuit of which, reduced to its essentials, is shown in Figure 3. The switches A and B correspond to the contacts on the vibrating reed. They are switched on and off alternately as the reed swings from side to side.

FLOW OF CURRENT

Because of this action, current flows from the negative centre-tap through alternate halves of the primary and back to the positive of the supply. This continual reversal of current in the primary results in a voltage being induced in the secondary, whose magnitude is dependent on the turns ratio of the transformer.

The shape of this induced voltage is approximately a square wave and its frequency is the same as the natural resonant frequency of the reed. For normal vibrators this is about 120 cps. It may then be rectified and filtered as required.

Now in the transistor circuit the path from emitter to collector acts as the switch. Two transistors are required and they replace A and B. They are switched "off" and "on" by passing a current into the base-emitter circuit in a manner to be described.

In this circuit the transistors can be

Figure 2: — The rubber box containing the transformer occupies most of the space inside the metal case. It is made slightly large so that the transformer will be held firmly with the assembly complete.

switched at a very high rate, sometimes up to 2,000 cps. This eases the filtering problem, since one large capacitor is often adequate at these frequencies. A mechanical switch, such as the vibrator, cannot reasonably operate at this speed.

The transistor has no moving parts to wear out and there are no sparking problems; also, because of the high frequencies employed, a ferrite core may be used in the transformer. Thus the supply is considerably reduced in size and is more reliable.

The circuits of Figure 4 illustrate adequately the action of the transistor as a switch while Figure 5 shows a basic converter circuit, with the base current controlling the switching being derived from the feedback winding. It works in the following manner.

FEEDBACK WINDING

When the low tension input is connected an equal forward bias is applied to the transistor bases. This causes a flow of collector current through both halves of the primary. One transistor will have a slightly greater current amplification factor than the other and hence the current through its half of the primary will be larger.

The feedback winding is connected with such a polarity that the voltage induced in it by the rising primary current adds to the forward bias on the heavily conducting transistor. Thus the collector current rises still further in this transistor and decreases in the other.

This process continues until the transformer core saturates at which stage there is no further increase in flux with increasing current. Hence the induced voltage in the feedback winding drops rapidly bringing about a consequent drop in collector current.

The falling collector current induces a reversed voltage in the feedback winding which then starts the other transistor conducting through the other half of the primary, and so the process goes on.

The frequency at which the unit operates depends on the effective primary inductance and stray circuit capacitances.

The waveform as it appears between emitter and collector of either transistor is seen in Figure 6. Sections 1-2 and 3-4 correspond to "switch-off" and section 2-3 to "switch-on." A fairly good oscilloscope is required, since the rise time of the spike is very short.

LIMIT THE LEAKAGE

The spike AC occurs just as the transistor is switched off. It is caused by the collapsing collector current inducing a voltage in the leakage reactance of the transformer. The magnitude of this voltage spike can easily exceed the maximum ratings of the transistor and, to keep it to a minimum, the transformer has to have interleaved and bifilar windings to limit the leakage reactance.

Also the magnitude of the spike increases as the load is removed from the converter, therefore some minimum load is generally indicated. Usually the converter will be more or less permanently connected to the equipment it is meant to supply when it is completed, so there will be no cause for worry.

HOW DC-DC INVERTER OPERATES

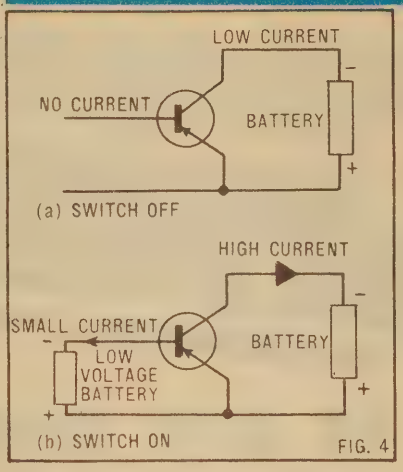


Figure 4:—The transistor used as a switch. A small current flowing in the base circuit is able to control a large current in the collector circuit.

Figure 5 (right):—A basic transistor converter circuit. The changing magnetic flux in the transformer core feeds current back into the base circuits and controls the switching action.

If a small capacitor is connected across the secondary of the transformer the height of the spike may be reduced just enough to bring it inside the safe limits for the transistor. It is necessary that this capacitor be the smallest that will just achieve this result, otherwise the efficiency of the converter will drop.

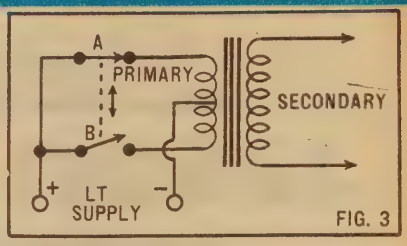
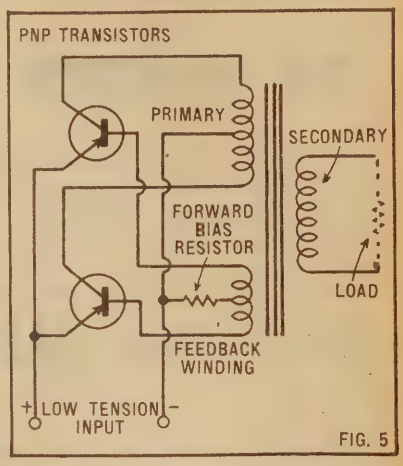


Figure 3:—This simple circuit is the basis of an ordinary vibrator power supply. The transistor supply works in the same way, with transistors substituted for the switches.



This is the purpose of the 0.0022 uF. 600 volt capacitor across the secondary in the final circuit diagram. Its value was selected with the converter fully loaded.

On the other hand the output may be

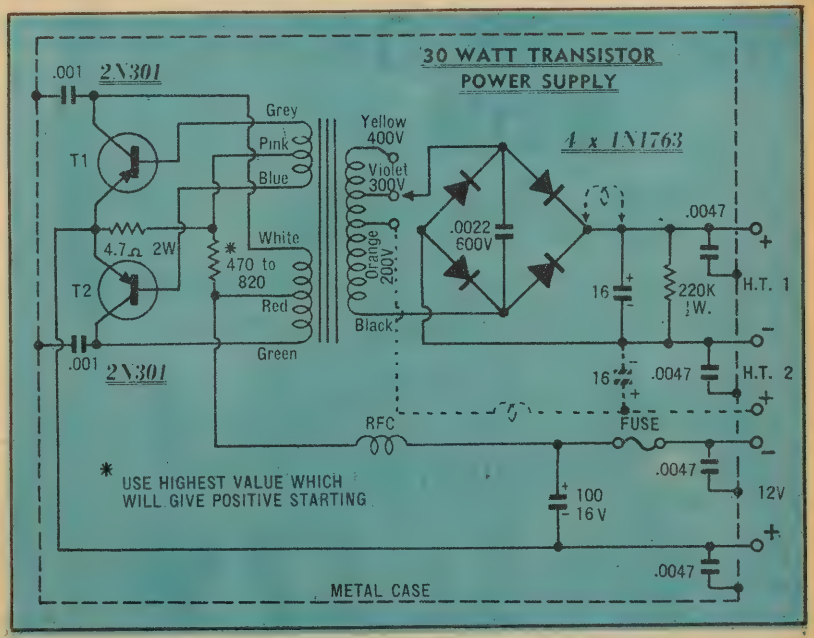


Figure 7:—Complete circuit of the supply. Capacitors bypassing transistor collectors to the case will only be required when the supply is used with a very sensitive receiver. In extreme cases, an RF choke in the HT line may also be desirable.

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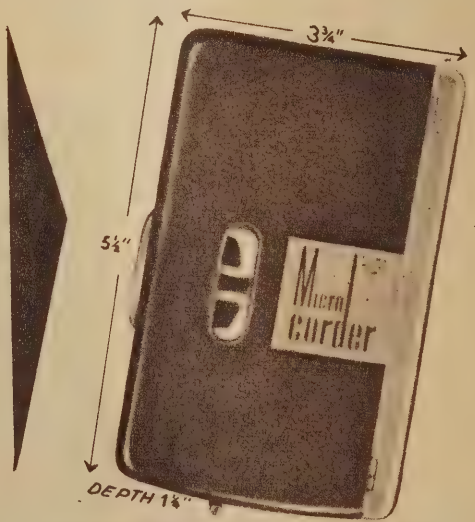

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completely short circuited without any damage being done. The input current falls to a few milliamps and the circuit just stops oscillating.

If the 400 volt tap is connected across the rectifiers, then the 200 volt tap becomes a centre tap. From this 200 volts DC may be drawn when wired with the necessary filter components shown dotted in the circuit. The total drain on the 200 and 400 volt supplies must not then exceed 40 watts.

The RFC shown dotted in the main HT lead is only necessary in extreme conditions. This also applies to the 200 volt centre tap if used. A 10 mH choke is adequate.

The divider resistors, in the base circuit of the transistors, bias them sufficiently far forward to ensure positive starting. The values required will vary with the particular transistors used. We suggest that you start with 820 ohms and reduce the value till it starts satisfactorily. In the case of 2N301s the necessary value was 470 ohms.

SOUND RADIATION

Another problem is that of sound radiation from the ferrite core, due to the magnetostriction effect. The converter operates at a frequency right in the middle of the audible range and it can become very annoying after a short while.

However in one respect it is handy since there will be no doubt that the circuit is or is not oscillating when you have constructed the converter and first switch on. If nothing happens reverse

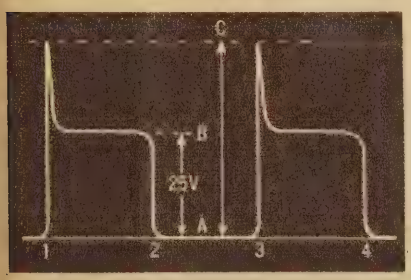

Figure 6:—This is the waveshape across one of the transistors. The peak voltage AC must not exceed the maximum published rating. For the 2N301 it is 40 volts in this service.

either the collector or the base leads and it should start.

The absorption of this audio energy has caused some headaches amongst designers of transistor supplies but we have arrived at a perfectly satisfactory solution. The transformer is completely surrounded by a close-grained foam rubber box, the dimensions of which are given in Figure 7 and which is pictured in Figure 2.

For the transistors we used 2N301s but there are other transistor types which will be suitable. OC16 is a possible though the output may be slightly less, due to a lower current gain. 2N250 has very similar characteristics and could probably be used.

For the bridge circuit other rectifiers may also be used. For instance the OA210 has similar ratings to the 1N1763. The IN1764 has higher ratings and is suitable but more expensive.

The components are assembled on a base plate with an outward turning lip.

DETAILS OF RUBBER CONTAINER

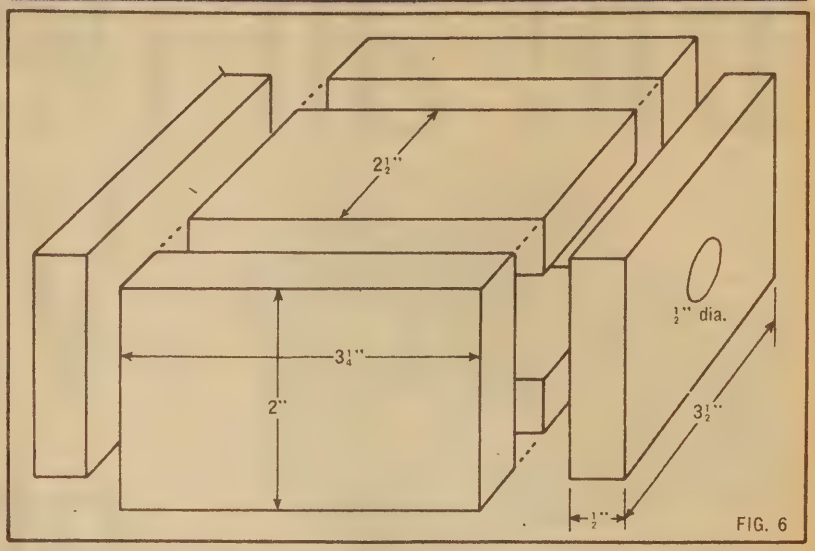

Figure 8:—Exploded view of rubber container for transformer. Fabricate from ½in close grained sponge rubber with cement. Rubber box should be assembled less end with hole, the transformer inserted, leads passed through hole, and finally the end cemented in place. When placed in metal box, transformer will be held firmly by rubber pressure.

This is evident from the first two photographs. The ceramic by-pass capacitors can lie flat on the plate under the rubber box. There is enough resilience in the sponge to accommodate these and the transistor pins which poke up through the base.

The remaining components are supported on two tag strips at one end. The HT filter capacitor is the largest item, so mount the tag strips so that this capacitor just fits between them and the end of the base. The other parts will then fit easily and there will be maximum room for the rubber box.

The transistors are insulated from the plate by mica washers, which are usually supplied with the transistor.

If not, they may be easily cut from scrap mica sheet. The idea is to split the sheet as thinly as possible, with say a razor blade, and then cut to size. As the voltages involved are quite small 0.005in is adequate.

LIMITING FACTOR

The transistors spend by far the greater proportion of the cycle either completely switched on or off. In this state the power dissipation within the transistors is quite small. The dissipation rises abruptly however during the small period when the transistor is changing over to on or off.

This switching time doesn't change much with frequency so that as the frequency of operation of the converter is raised the average dissipation goes up. This is one of the limiting factors influencing the design of such a unit.

In our case the average dissipation is such that the heat sink requirements are quite light and the base upon which the transistors are mounted is adequate.

The terminating strip is also mounted on the same side as the transistors. The lip then protects them all. A fuse is incorporated in the form of a piece of 0.01in tinned copper wire held between two of the terminal screws.

Both the low tension and the high tension circuits in the supply have been insulated from the case. Either polarity may therefore be used for both the input and the output, so long as the maximum ratings of the RF bypass capacitors is not exceeded.

A lid, measuring 6in x 3½in x 2½in deep, slips over the whole assembly and is screwed to the lip of the base. This lid just squeezes the foam rubber box enough to hold the transformer firmly. When mounted in this manner the supply is virtually silent.

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BUILDING AN "ELECTRIC BRAIN"

Our article on logical machines in the November, 1959, issue, and Mr Molesworth's discussion of it in the January, 1960, issue, have aroused interest among readers in the possibility of building an electrical brain. Mr Molesworth, who is both a logician and an amateur radio operator, says we can do the job. He sets out enough of the logic to get us going: the rest is pliers and solder.

By Vol Molesworth, M.A.

THE human brain is a machine which reasons. We can design a machine which does the same job, electrically. Perhaps we can be forgiven if we follow the comic books and call it an "electrical brain."

What is reasoning?

As defined by Aristotle, reasoning is "a process in which, certain things being laid down, something other than these necessarily comes about through them" (Topica, 100a25).

When we reason, we take a fact and see what follows from it.

We may, of course, begin not with a fact but a hypothesis, and see what would result if the hypothesis were true, but the true-or-false nature of our starting-point does not affect the validity of the reasoning process.

We can reason, with equal validity, from fact to fact, or from fantasy to fantasy: but it is the process of reasoning, the method by which we move from A to B, rather than the truth or falsity of A or B, which is our present concern.

We will not get very far in our reasing, however, if we concentrate on one fact alone. The notion that we can select one datum about the universe and from it deduce everything else in the universe is illogical.

STRICTLY LIMITED

From one fact alone we can infer only those other facts immediately deducible from it, and there is a strictly limited number of valid immediate inferences which can be drawn from a single fact.

Coupling our fact with some other fact is more fruitful. The process was introduced by the Greek philosopher, Socrates (in the dialogue, the Phaedo) and systematised by the real founder of logic as a science, Aristotle.

When we couple two facts together, we make a "mediate" inference, the best-known kind being a syllogism. This comes from a Greek expression meaning "to reckon together." The two facts we couple together become the premises of the syllogism, and a new fact emerges as the conclusion.

For example, given the premise that curious people inevitably make discoveries, and the further premise that all radio experimenters are curious people, we may reasonably conclude that all radio experimenters make discoveries.

This is, in fact, a syllogism, properly set out as follows:

MAJOR PREMISE: All curious are discoverers.

MINOR PREMISE: All radio experimenters are curious.

CONCLUSION: All radio experimenters are discoverers.

This is an example of Figure 1 of the syllogism, which Aristotle regarded as the model of human reasoning.

There are four figures of syllogism, three worked out by Aristotle and the fourth by Galen but, for the time being, let us stick to the first figure only. It will mean a smaller electrical brain, and we can build in extra circuits for the other figures later.

MECHANICAL REASONING?

Can we build a machine which can carry out reasoning processes like the one above? Certainly we can. All we need do is find some means of electrically representing each of the premises, and some means of coupling these premises together to produce reasonable answers.

Having designed such an electrical brain, we can then feed in premises to our heart's content and without further ado read off the conclusions, knowing that—unless something goes haywire in our circuitry — the conclusions we get will be absolutely reliable.

When something goes haywire in human mental circuitry, people develop crazy ideas. Likewise, if a resistor goes high or a relay jams, our electrical brain will produce crazy answers. It will go insane.

It will no longer be a reliable box of nuts and bolts. It will simply be nuts!

The important point is that we can make an Electrical Aristotle. But before we plug in the soldering iron and haul out the junk box for suitable components, let us sit back for a moment with our feet on the bench and think about the theory of syllogism.

Take a look at the syllogism above. First, you will notice it is made up of three separate statements—two premises and the conclusion. The premises are given, the conclusion is the "something other which comes about through them," as Aristotle said.

In logic, these statements are called "propositions." They are things proposed for consideration. We are not especially concerned with their truth or falsity: all we want to know (in reasoning) is whether they hang together.

Each proposition is complex: it contains two terms, a subject and a predicate, related qualitatively (in our example, the quality of each proposition is positive) and also related quantitatively (in our example, the quantifier of each proposition is universal).

VARIABLES

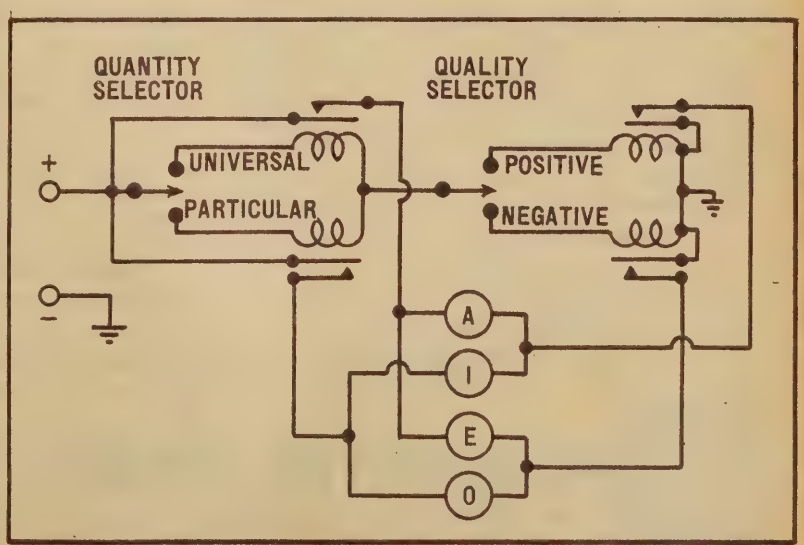
Now, it is obvious that both the quantity and the quality of propositions can be varied. We can consider "all" or "some" of any subject class, i.e., we can employ universal or particular quantifiers; and we can refer to characters which the subjects lack, as well as characters they possess, i.e., we can have negative or positive propositions.

By varying first the quantity, then the quality, we derive four possible forms of proposition.

UNIVERSAL AFFIRMATIVE: All X are Y (known as "A").

PARTICULAR AFFIRMATIVE: Some X are Y ("I").

UNIVERSAL NEGATIVE: No X are Y ("E").



A premise-making "machine."

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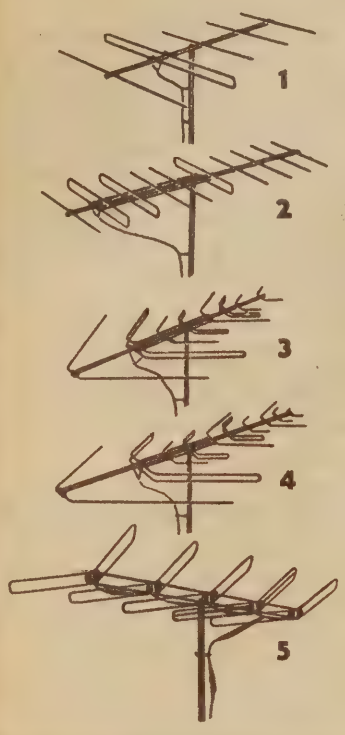

1. LB5 Expressly designed for efficient reception on Channel 2, the LB5 antenna provides good gain and front to back ratio. For poor signals or fringe areas, this 5 element yagi can be combined with HB55 by interconnecting with IC56 bars. £6/12/6 Freight Forward.

2. HB55 A unique arrangement of two 5 element yagis in Co-linear form. The whole combination consists of 3 folded dipoles, 6 directors and a reflector and the resultant performance is outstanding in gain, front to back ratio and acceptance angle. Two of these antennas can be stacked using stacking bars SB33 with a corresponding increase in gain. Gives excellent all-channel reception in difficult areas. £7/12/6 Freight Forward.

3. GB8 This array is giving astounding results in fringe and low signal areas with its high gain and directivity. The combination of 3 elements on low band array with 5 elements on high band has produced excellent pictures in areas that have previously been considered impossible. £7/2/6. Freight Forward.

4. GB10 The fringe antenna is necessarily a complex array with its requirement of high directivity and gain on all channels. The GB10 combines a reflector, dipole and two directors on low band with a reflector, twin phased dipoles and 3 directors on high band. All elements are Vee'd in conformity with the other antennas in the "Ghostbreaker" range. This array in single and stacked combination has produced excellent pictures at extreme ranges from the transmitter. £9/19/6. Freight Forward.

5. "TRAVELLING WAVE" AERIALS "Travelling Wave" aerials are the latest development of TV aerial research. The "Travelling Wave" principle electronically reinforces picture signals on ALL VHF stations, thereby eliminating "snow". This aerial design is also extremely effective in rejecting unwanted signals (cause of such common problems as "ghosts", "venetian blinds", etc.). The TW is bringing clear reception to "deep fringe" areas throughout Australia. 3 Element, £10/19/6. 5 Element, £18/18/-. Freight Forward.

5 ELEMENT HI-BAND YAGI No. 607/9. (not illus.)
Ideal Aerial for Channels 7 and 9 in bad areas. 69/6. Freight Forward.

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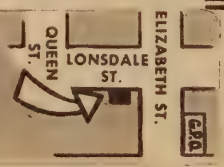

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PARTICULAR NEGATIVE: Some X are not Y ("O").

An easy way to remember the symbols for the forms is that "A" and "I" are the first two vowels of "affirmo" and "E" and "O" the two vowels of "nego."

Propositions are our basic logical tools. Any situation whatever can be conveyed by putting it in the appropriate logical form.

For example, "Women never lie" becomes "No women are liars"; "You will occasionally find a sensible TV salesman," "Some TV salesmen are sensible"; "Not all politicians are corrupt," "Some politicians are not corrupt."

SIMPLE DEVICE

Our first job, then, is to devise a means of setting up propositions. We can do this with a couple of switches, four relays, four globes, and a battery. (See circuit herewith.)

Built it? Good, now build another exactly like it, and we have two proposition-making devices which will enable us to set up premises for our syllogisms.

At first sight, it would appear that we can have premises and conclusions in each of the four forms, which would give us 4 x 4 x 4 equals 64 possible syllogistic hook-ups. This would call for a great deal of wire, and some really ingenious colour coding. But fortunately Aristotle has saved us a lot of trouble here.

You will notice in our sample syllogism that although there are two premises, they contain not four, but only three terms. One term ("curious") is common to both premise. This is our "mediate" term which marries the premises and legitimises their offspring.

Aristotle discovered that the common term must be distributed at least once. This means it must occur somewhere in the premises as the subject of a universal or the predicate of a negative. This saves connecting up a number of globes, and spares several feet of hook-up wire.

He also discovered that at least one of the premises must be universal. (More hook-up wire saved.)

ARISTOTLE

Aristotle discovered other rules, which you will find in the text-books, which show that only six combinations of premises produce valid conclusions in a first-figure syllogism. There is no point, for example, in connecting two negative premises: no valid conclusion can follow.

We can proceed now to hook up our two premise-making devices, and with the aid of four more relays (two of them double contact types) and four more globes, we can build our first electrical brain.

You will notice that each universal conclusion returns to earth through its corresponding particular. This is because whenever the universal is true, its particular must be true. If all men are mortal, then any given set of men must be mortal.

Now let us test the brain. Think of "females." (That's easy). What is true of them all? They're kind. (Is he kidding?) This gives us the major premise: All females are kind.

Two switches click, and the "A" globe lights up for the major premise. At the same time a plus voltage is connected to two relay-possibilities in the minor premise—the "A" and "I" globes.

Now for our minor premise. Think of "wives." Are they all "female"? (We have to get our middle term). The answer is obviously "yes," so we select the appropriate switch positions for another universal affirmative, "All wives are females."

MINOR PREMISE

Now the "A" globe lights on the minor premise line, its relay closes, and current goes to earth via the "A" and "I" conclusion globes.

We have electrically demonstrated the syllogism:

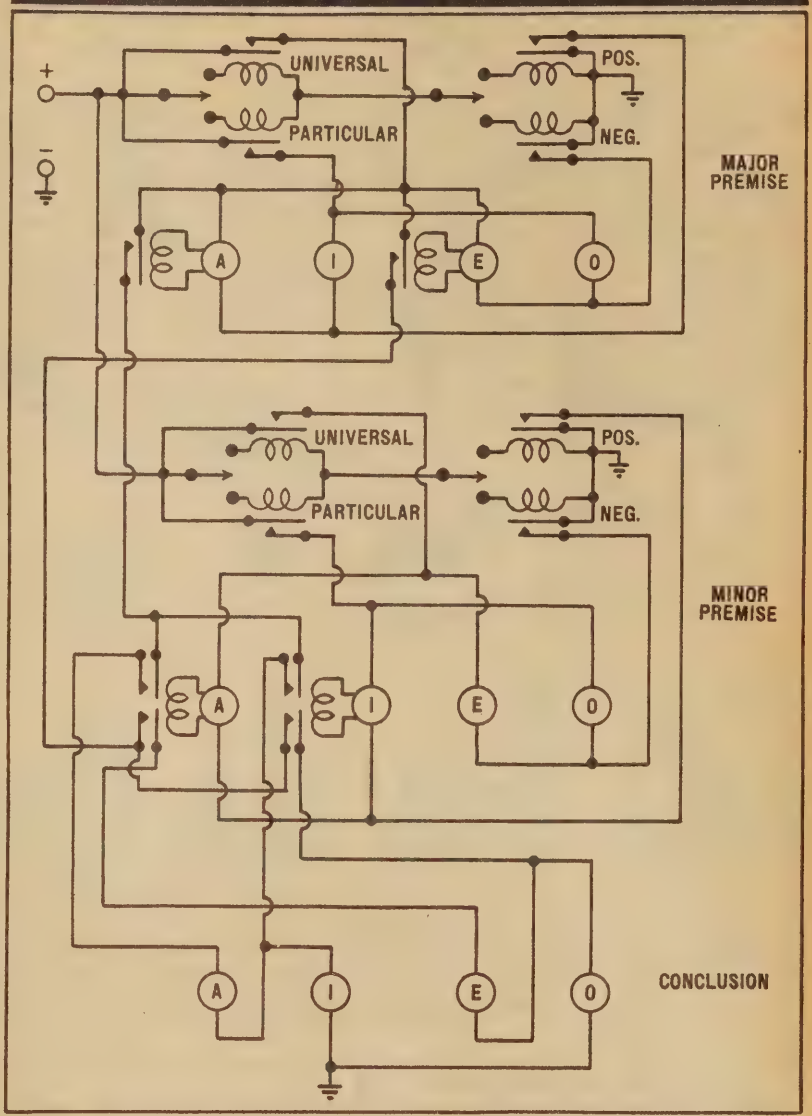
All females are kind.

All wives are females.

Therefore: All wives are kind.

If the premises are true, the conclusion follows rigorously as a matter of logical truth. (If you doubt the conclusion, then one of the premises must be false).

ELEMENTARY ELECTRICAL BRAIN



This elementary "electrical brain" can evaluate propositions to produce "conclusions." The author claims that it can illustrate other processes of logic not discussed in the article.

Now let us take "No nice people are tax collectors" as our major premise (the "E" globe lights), and "All my friends are nice people" as our minor premise (the "A" globe lights); the conclusion follows logically that none of my friends are tax collectors ("E" and "O" globes).

We can also use our relay-operated brain to test hypotheses. What we do is set up our hypothesis as the major premise, then find some well-tested fact with which to couple it as our minor premise. If the conclusion is false, the hypothesis must be false.

For example:

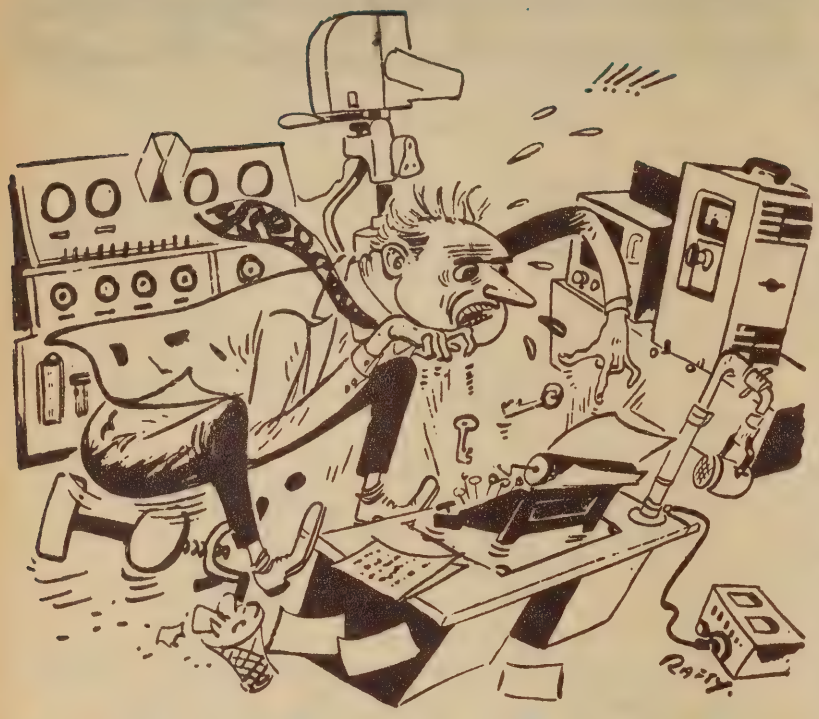
HYPOTHESIS: All taxis are cars painted yellow.

FACT: All Green Cabs are taxis.

CONSEQUENCE: All Green Cabs are cars painted yellow.

Since the conclusion can be observed to be false, one of the premises which imply it must be false. We know the

(Continued on Page 93)



ing the original correspondent's query, I can only apologise and most humbly.

But having re-read the letter on page 91 of the December issue, no sense of guilt is created. I still think the writer was in need of some very elementary assistance and was not, in fact, worried by the maths involved.

As evidence of this, I would point out the sentence in which he speculates that the phase splitter may hold the explanation "in some wonderful way".

Here's hoping that the original explanation was, in fact, helpful.

WELL SAID!

However, that does not mean that M.R.W.'s contribution is not a worthy one. His sentence is rather good which reads "Hence we can see that current change in one half of the primary has minus the effect of the same change in the other half".

In fact, I wish I'd thought of the expression first.

The second letter, in the panel opposite, cannot be dismissed or got around in any way I can think of.

As the Serviceman says elsewhere in the issue "Touche" or, in plain Orstralian, "Yer got me there, mate."

I suggest you read the letter and see why. If the point is not immediately obvious, have a look at the sketch opposite.

Let's Buy An Argument

One can never be sure of anything in this "Argument" business. When I answered the letter in the December issue "How Does Push-Pull Work," I felt reasonably certain that the subject had been disposed of. But no! Someone wasn't satisfied.

IN fact, I should perhaps add that someone was VERY not satisfied. He feels rather badly let down.

His letter reads as follows:

"Dear Sir,

"It appears to me that you have beautifully sidestepped the question in hand in reply to K.H.s query on push-pull amplifiers. You have supplied a well-framed description in elementary terms of how push-pull produces an output at the transformer secondary.

"This is an explanation eminently suitable for the beginner but the original question 'But where have we gone wrong in our deductions?' is obviously based on mathematical reasoning.

RIGOROUS TERMINOLOGY

"The confusion arises when rigorous terminology is not carried through; K.H. says 'if two sine waves 180 degrees apart are fed together' when instead he should have said 'added together'. At this point the flaw in his reasoning would become clear.

"A push-pull output transformer is a subtractive device. The two primary halves are reverse connected, and their effects are added vectorially by the core, before transmitting them to the secondary.

"Hence we can see that current change in one half of the primary has 'minus the effect of the same current change in the other half'.

"Then we are subtracting two sine waves 180 degrees out of phase, or differently, we add two sine waves in phase, giving just double the amplitude of each component waveform.

"Certain simplifications in transformer theory may be obvious, but they are valid, at least for these considerations. Hoping that this may be of some help to K.H. and other readers,

Yours faithfully,
M.R.W."

Well, there it is.

If I have been guilty of misinterpreting the original correspondent's query, I can only apologise and most humbly.

But having re-read the letter on page 91 of the December issue, no sense of guilt is created. I still think the writer was in need of some very elementary assistance and was not, in fact, worried by the maths involved.

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I suggest you read the letter and see why. If the point is not immediately obvious, have a look at the sketch opposite.

by Neville Williams

The heaters in the 1959 TV receiver are supplied from a 12.6-volt winding whose centre tap is earthed. One side of each heater is also earthed but the active runs are grouped so that the load is fairly evenly distributed between the two halves of the aforesaid winding.

The situation could be regarded as shown in the diagram, in which the two heater groups are represented by two resistive loads of approximately equal value.

NECESSARY, VALID

The earth return shown at the point where the loads join is necessary and valid because, in the actual wiring of the receiver, each individual heater is connected to an earth point adjacent to the socket. It follows that the heater current for each valve flows to chassis through its own earth link. About this there can be no argument.

However, in writing the article, I tacitly assumed that the total arithmetic sum of all the heater currents would flow through the winding centre-tap-to-earth circuit, amounting to 10 odd amperes. Therefore the earth return had to be of low resistance.

However, the assumption is wrong, as

our correspondent points out and the heaters would continue to operate fairly normally with the centre-tap completely disconnected. The two loads would simply be in series across the total supply voltage and, being reasonably balanced, would share that voltage fairly equally.

Of course, one would hardly advise operating in this condition because any unbalance, either initial or due to valves being withdrawn or failing, would cause other valves to be over-run. So an earth return is logical and desirable.

However, the current flowing through this common earth link is not the arithmetic SUM of the network currents but the DIFFERENCE. Perhaps we might make our earlier correspondent happy by specifying it as the VECTOR SUM of the currents.

This our correspondent works out at 0.71 amps, which is a very different figure from 10.

HIGH CURRENT

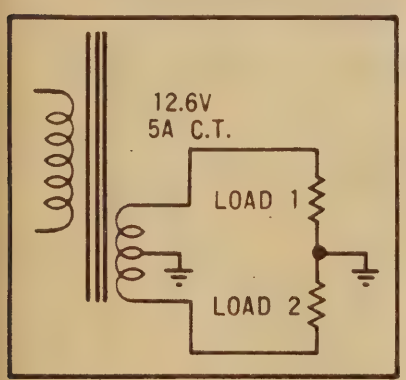
But then, of course, that is under ideal balanced conditions. In the earlier stages of testing the receiver, with only one heater network in operation, there would be no cancellation and 4 or 5 amps would be flowing through the earth link.

Do you know what?

I still suggest that the earth return for the heater winding be made electrically effective, since it may have to carry substantial current in some circumstances and, in any case, is responsible for maintaining the balance of voltage between the two heater strings.

On another subject, our friend who "answers Tom," has let himself in for another argument.

In the October, 1959, issue, the question was posed: "If I were to connect a filament transformer, giving 6.3 volts from the power mains to a vibrator set, would it function?"



In the above circuit, how much current will flow through the earth return to the winding C.T.? In some circumstances, the answer is —not much!

The answer was "no," the text then going on to point out the difference between synchronous and nonsynchronous circuits. It concluded with the suggestion that, even if the vibrator did manage to operate in some kind of fashion, assuming the non-synchronous circuit, the output voltage produced would be "anybody's guess."

Two readers have protested, however, on the very strong grounds that they have tried it—and it works.

FIVE AND FIVE DON'T MAKE TEN

Dear Mr Williams,

Having enjoyed for years reading of others who "Buy an Argument" with you, successfully or otherwise, I have at last found just cause to do so myself.

In the August 1959 issue, page 75, para. 5 of column 1 we read: (referring to the heater winding of the power transformer of the new TV set) "Make sure to tie the lug providing the heater CT earth to at least two other adjacent earth points. Something like 10 amps. of current are flowing in this circuit."

Need I continue? Well, it's my 5d stamp, so I may as well get my money's worth out of it, so here is my side of the "argument."

On the "X" side of the heater circuit we have 10 valves drawing a total of 4.76 amps. heater current. On the "Y" side we have 3 valves and the picture tube drawing a total of 4.05 amps.

The net current in the centre-tap-to-earth connection is therefore 0.71 amps., since the current from one half of the winding flows "out" when the other half's current is flowing "in" to the centre-tap.

Of course, as the centre-tap is usually two wires which must be connected together to complete the circuit through the winding, this joint must be good, but the actual earthing connection only carries the 0.71 amps.

Thanks for the opportunity to "have a go"; such chances are few and far between in your publication.

Yours sincerely, F.A.W.

VIBRATOR RECEIVERS

Dear Sir,

In your Answer Tom pages, I see that the answer was "no" to a question, "If I were to connect a filament transformer giving 6.3 from the power mains to a vibrator set, would it function?"

I would like to say that this arrangement would work if the vibrator was of the non-synchronous type. However, when the vibrator is a synchronous one, the arrangement will not work. The above is based on my own experience and information.

An actual example is a 12-volt car radio run from the 5v and 6.3v windings of a power transformer. The windings are connected in series, the set having a non-synchronous vibrator.

I stand corrected if I have overlooked a detail which may render the non-synchronous set-up useless in some cases.

B.F.A. (Islington, N.S.W.).

VIBRATORS AGAIN

Dear Sir,

Might I suggest that the paragraph from "Answer Tom" on the subject of vibrators is a case of too much theory and too little practice.

In an emergency, with no car battery available, I have driven several different brands of car radio from an A.C. supply. These included one of the R. T.V. and H. car radios.

The result is, of course, not ideal, the main noticeable effects being a surging buzz from the vibrator instead of a smooth buzz and a varying H.T. voltage in sympathy with this surge. However, this surge is not too bad.

The set-up is quite adequate for a check of a dead set.

J.C.R. (Wallsend, N.S.W.).

Reading back over "Tom" and the letters, all have suffered from brevity and a few "fill ins" may help matters.

First of all, the original questions did not specify a car radio but a "vibrator set." The difference could be important as far as Tom is concerned, anyway.

A vibrator set could as well mean one operating in the home from a storage battery and using directly heated type valves.

Any attempt to operate such a set from the A.C. power mains would undoubtedly be unsuccessful for two reasons.

Firstly, how much voltage reached the heaters would be dependent on the filter system, which is expressly aimed at blocking any ripple component. But assuming enough voltage got through to light the filaments, the presence of A.C. on the filaments and, therefore, in the bias network, would produce intolerable hum.

Also the high tension supply in such a receiver would invariably involve a synchronous vibrator which would produce no useful H.T. voltage from an A.C. input.

As I see it, each two alternations of the vibrator would produce alternate positive and negative outputs, which certainly wouldn't add up to very much.

With a car radio the filament problem would not arise since it would use indirectly heated valves. But I still frankly fail to see how it could work if it used a synchronous vibrator.

During input half cycles of the correct polarity for the receiver, the vibrator would effect two (approximately) makes-and-breaks and produce two pulses of H.T. output of the correct polarity. But during the following two makes-and-breaks the H.T. output would be reversed, effectively cancelling the preceding pulses.

One might suggest that the electrolytics would effect a rectifying action because of their different forward and reverse resistance but what a horrible thought that is!

Which leads to the conclusion that the only vibrator type receiver which could

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be expected to operate from an A.C. input would be a car radio with a non-synchronous rectifier system. The sets which have formed the basis of our correspondents' experiences, have probably been of this type—and after all, they are quite numerous.

The varying surge which J.C.R. mentions would have to do with the beat which would occur between the 50-cycle mains frequency and the natural frequency of the vibrator reed, which could be substantially different from 100cps.

But then, of course, some vibrators may tend to lock with the mains frequency, thus obviating any beat effect.

At this point I should pause to acknowledge some letters which have come to hand, but which do not happen to fit now into the pattern of correspondence.

On the subject of electric shock, which received quite a doing in recent months, I have a letter to hand from C. McD., a New Zealand reader. He tells of a severe 240 VAC shock, received between the hands while atop a power pole.

FINE—TILL IT BROKE

It happened when he found it necessary to open an earth link wire in a circuit, which he understood to be dead. Rather than climb down the pole for his cutting pliers, he gripped the loop in his two hands and worked it back and forth till the wire parted.

The circuit wasn't dead, but he nearly was!

That happened at the age of 18, and he feels that the shock started a process which culminated in severe coronary thrombosis at 54 years of age. He says:

"I feel that only those who have actually experienced the horrible intensity of such a shock to the nervous system are qualified to express views on the subject."

To C. McD. I can only say, "I'm not the least bit jealous."

From C.T., another New Zealand reader, comes the observation that he has noted oscillographic presentation of the waveform of impulses passing through nerves to various muscles. The equipment is used, he says, to analyse the nature of paralysis, and to indicate the type of treatment which seems necessary.

Since the impulses appear to fall freely into the region of 20 to 200 cps, he assumes that the muscles will respond most readily to excitation within this frequency band, and, of course, it includes the power frequencies.

STRENGTH OF MUSCLES

He goes on to suggest that the behaviour under shock is largely dependant on which muscles happen to be activated by the current and the relative strength of those muscles.

Since the muscles which close the hand are generally stronger than those which open it, the chances are that the net effect of shock will be to make the hand close—possibly on the source of the current. Hence the "holding" idea.

This is in line with some previous correspondence.

From Victoria comes a letter signed by K.M. It is not intended to be a learned treatise on the whys and wherefores of electric shock, but is a statement of facts, as seen by a practising electrician.

We can best quote from his letter,

LIGHT-WAVE TRAIN OR MATTER

Dear Sir,

I read with interest the second half of R.M.'s letter regarding light as an e.m. wave or matter.

I hope to be able to indicate to R.M. and other readers that, concerning "Waves or Particles" (a) Light is both; (b) matter is both.

As far as light is concerned we must produce a theory that satisfies several well-known and observable facts. These are:—

(i) Light is a form of energy. (ii) Light can travel through EMPTY space. (iii) Light can travel in straight lines. (iv) Light obeys law of reflection and refraction. (v) (And this one is very important) Light may undergo simultaneous reflection and refraction at a boundary between two mediums. (vi) Light has a characteristic speed and lastly, as R.M. mentions (vii) light can be broken up by prism into different colours.

All these facts were known in the days of Newton, who put forward his corpuscular theory that light consisted of particles. All the points mentioned above were satisfied assuming elastic collisions, until we came to point (v). Here Newton said light had "fits" of easy reflection and refraction.

Also point (vi) was difficult to expound but Newton eventually (somehow) obtained an answer, although the velocity was dependent upon the source velocity.

Maybe, much to R.M.'s surprise, Newton also said that the particles were of different sizes and hence refracted by different amounts, hence explaining light being broken up by prism.

Hughen placed before us his theory that light consisted of waves and was transmitted in some sort of medium, the aether. This theory was also partially successful, point (v) being compared with sound which was both reflected and refracted at the same time and point (vi) by the fact that the aether had the right elastic properties.

Our friend Einstein said in 1905 the e.m. radiation was emitted in the form of particles of energy, quanta or photons. E.m. radiation was actually e.m. waves. Hence dilemma, waves or particles, light can't be both at the same time?

This argument was carried one step further by Mr L. de Broglie (1924). He said in an hypothesis "this apparent dual character of light, wave or particle, should not be confined to e.m. radiation alone, but should also be exhibited by ALL the fundamental entities."

This means that electrons, protons, atoms, molecules should have some type of wave motion associated with them, even though they are generally regarded as matter (with finite mass).

Since this hypothesis many famous men have shown that wave nature is associated with particles. Some of these men have been Davisson and Germer, G. P. Thomson and de Broglie himself.

Hence the answer to the dilemma whether light is waves or particles is that it is both.

Although this is the end of the argument in question, may I point out that aether is not necessary when talking about e.m. waves.

Free space has infinite resistance (as regard to e.m. waves propagation of energy) and the transmission of energy through free space was investigated by an obscure man called Poynting.

Other men also have had a hand in the business.

As far back as 1864 Maxwell showed that a disturbance consisting of electric and magnetic fields SHOULD be propagated through the aether with the speed of light. (The aether then was regarded as being luminiferous, filling all space, and having some of the properties of an elastic solid.)

Hertz (1887) showed the correctness of Maxwell's theory. Einstein's theory of relativity (1905) showed that aether was not necessary for the propagation of electromagnetic (e.m.) waves.

As a consequence light, in wave form, is regarded as electromagnetic oscillations, consisting of variations in the intensities of transverse electric and magnetic fields, each of which may exist in free space, that is, space completely devoid of matter.

Yours sincerely, P.B.

LIGHT WAVICLES

I was interested in a letter about space in the September issue. The writer may have something.

Light has been defined as a "wavicle"; that is it shows that it operates as an "immaterial" frequency as well as minute particles.

According to certain occult sources, space is defined as being full of matter in varying tenuous states; light is a magnetic phenomenon in which infinitesimal "needles" are arranged in the strong magnetic field of a sun or star's photosphere, giving the observer the standard sensation of light.

When a non self-luminous body such as the night side of the earth is interposed, the needles in its path become higgledy-piggledy, giving darkness.

When a star shines, its weak magnetic field (at this distance) lines up the "needles" in its path and we "see" the image of the star.

In white light, the seven primary colours exist because the natures of frequency vibrations are such that differing frequencies can exist in the same space at the same time but, should they heterodyne, new frequencies are made.

Yours faithfully, M.Q.

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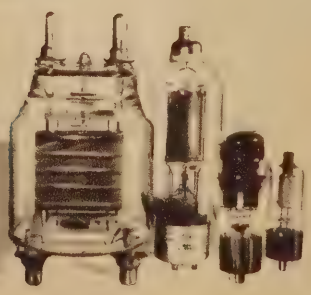

and, for the time being anyway, let us close the subject. I quote:—

"Despite the interesting theorising published, it is my experience that the difference in effect of AC and DC is about parallel with the difference in effect of a level crossing impact with a steam or diesel train. The end result is much the same, only you may be "deader" from the effects of the heavier steam job.

"It seems to me there is more of account in 'How you are hit' than by what.

"The 'holding' effect appears similar for both sources under most conditions of exposure to the full line voltage (200-400) and is dependent, in the main, on the physical and mental attitude and condition of the victim and the circumstances at the time prevailing.

"TO HANG ON"

"For my own part I have never yet experienced any desire to 'hang on' (may be due to luck) and have always removed the contact, just as promptly as one does from an article found to be thermally hot.

"In fact, I can't recall ever having an 'opportunity' to observe if there was any particular difference that would indicate whether the source was AC or DC. The 'vigour' of the AC may be more pronounced, due to the higher peak volts.

"In addition to electro-muscular reaction, could not the 'throwing' effect be stimulated by 'fright' in a similar manner to one's reaction to the disruption of one's pipe-dreams when some clot 'boos' loudly in one's ear?

"Some people are far more susceptible than others, being 'knocked' by the faintest 'bite,' whilst one character of my acquaintance was observed to lick his fingers to enable him to identify 230v AC busbars from those at 400v.

"In conclusion, the Serviceman's statement to the effect that the only safe power line is a DEAD one be it AC or DC' deserves the most vigorous endorsement. If one must work on 'Live' line, alertness and caution is one's best insurance.

"If familiarity leads you to contempt, you're for it sooner or later!"

Yours, K.C.M.

From a reader in New Zealand comes a letter inquiring about "An amazing new unit," which he has seen advertised and which allegedly provides an inexpensive and efficient method of recovering picture tubes which have suffered a premature failure of the heater.

It is also possible (allegedly) to cure tubes suffering from cathode poisoning.

He asks whether it is not, in fact, true that heaters which have failed can only be replaced by opening the tube and whether cathode poisoning is not a chronic fault, incapable of ready cure.

Not having seen the advertisement in question, I hesitate to say too much. However, the original product would sound very much like a device to boost the heater voltage, while the statements may be those of an enthusiastic but not very well informed advertising copy writer.

Last, but not least, a couple of readers seem to be quite concerned lest we journey too far into 1960 without having been made "clear" in our minds as to the nature of light.

As I've said before, I find it hard enough to keep up with the "Radio, Television" part of our title, without trying to joust mentally with those whose "Hobbies" include (in this case) physics and the occult.

But their letters are included for the sake of others who may be so inclined.

ELECTRIC BRAIN

(Continued from Page 87)

minor premise is true (that's why we picked it), so our hypothesis is automatically knocked out.

The brain can be used, also, to find premises to support various beliefs we hold. (If, of course, we can find no true premises, or facts, to support our beliefs, then we must give up the beliefs).

There are various other logical operations which our machine can perform, its only criterion being reasonableness. It tells us what follows from the data we set up: we have to check the data (and also the conclusions produced) ourselves for truth.

The machine can do our thinking for us, but it cannot tell us that we started off on the wrong foot.

Our T-model Electrical Brain, however, calls for four switches, a dozen relays, a dozen globes, and a battery capable of handling all these relays and globes.

We could design a brain employing standard radio components, such as valves or transistors. Then we really would have an Electronic Brain.

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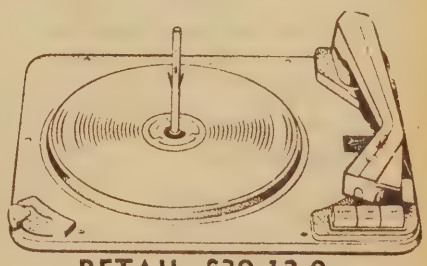

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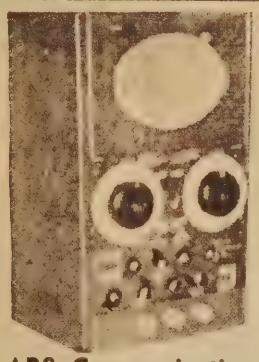

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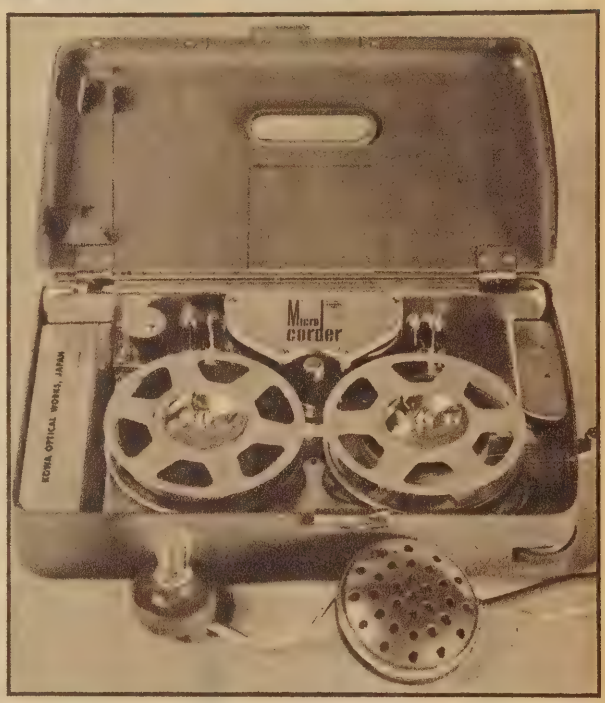
TRADE REVIEWS AND RELEASES

MINIATURE BATTERY-OPERATED TAPE RECORDER

Those who have need for a miniature, portable battery-powered tape recorder, will be interested in the Kowa Microcorder, now being imported and sold by Esdaile & Sons Pty. Ltd.



OVERALL dimensions of the Kowa Model 101 Microcorder are only 6in by 3¾in by 1¾in and weight approx. 1¾lb, including batteries and tape. It could be carried in a coat pocket, when only a microphone and headpiece are needed externally.

Four penlite cells power a governed motor, which drives the tape at about 1¾in per sec. while a 9V battery, also housed internally, supplies the 3-transistor amplifier.

Standard ¼in tape is employed, allowing a recording time of 15 minutes per track on a dual-track system. Reversing and track change are automatic so that the recording time is virtually 30 minutes. Battery life is about two hours, but larger external batteries or a rectifier supply operating from the mains, available as an accessory, can conveniently be plugged into the socket provided.

Far from being a toy, the Kowa 101 is a well designed, beautifully finished machine, which we would imagine would give reliable service in all applications where extreme portability is required. A businessman travelling by car or air, for example, could very conveniently use it for making notes or dictating letters. Quality through the earpiece is clean and clear, although not high fidelity.

Musical recording is feasible, but contains some evidence of "wow."

Naturally facilities such as fast forward and reverse and inbuilt speaker are omitted. Erase is by an electromagnet.

Accessories listed include an auxiliary battery supply, AC power supply, loudspeaker, transistor radio, wrist watch microphone, spare reels and case, etc.

The Microcorder is imported and sold by Messrs. Esdaile and Sons Pty. Ltd. at 42 Hunter Street, Sydney, and through their branch stores. The price quoted is £79.

NEW PICTURE TUBE "BRIGHTENER"

Some picture tubes have now been in service long enough for their emission to have fallen and the picture grown dim in consequence. Owners — or service organisations — are faced with the alternatives of replacing the tube or using a "Brightener."

ESSENTIALLY, a picture tube "brightener" is a small auto transformer, which boosts the heater voltage slightly.

The increased higher cathode temperature which results, raises the emission and extends, somewhat, the tube's useful life. The idea is widely used overseas.

The unit pictured at the left is wired so that it simply connects in series with the leads to the picture tube base.

Manufactured by Messrs R. W. Steane under the brand name "Q-Plus," it is available through trade houses.

NEW HI-FI SHOP

TO mark the opening of Australia's newest Hi-Fi shop "Mastersound," 400 Kent Street, Sydney, the directors organised an essay writing competition on the subject "Stereo and Hi-Fi . . . are they really worth it?"

Many will recognise a similarity in this heading to a series of Readers' Letters (Hi-Fi, is it really worth it?) which appeared last year in the overseas periodical "The Gramophone."

Judging by the response, Australian audio fans have equally strong feelings on the subject, with one difference: every single entrant expressed a distinct liking for high quality sound.

The winning essay was selected out of nearly 600 entries. It was submitted by Mr H. Lloyd-Jones, 4 St. Anthony's, 159 William Street, Sydney.

Judging was under the supervision of Mr Ken Page, of Magnavox Ltd.

For his composition, Mr Lloyd-Jones will receive the first prize, namely a Myer 10-watt Stereo Amplifier, valued at £52/10/.

An interesting item to be seen, or rather heard at "Mastersound," is the "Wall of Sound." This is an acoustically transparent, though optically opaque wall, some 16ft in width, behind which are mounted up to 18 different loudspeaker systems. Any pair of speakers (stereo) or single speaker (mono) can be made to play in conjunction with any amplifier or pickup, via a system of push buttons, as found in overseas hi-fi shops.

The listener is thus never distracted by the location, shape, or colour of the loudspeaker cabinet and is aware only of the sound itself.

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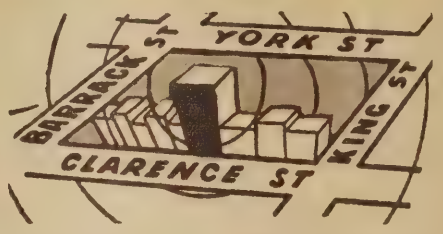

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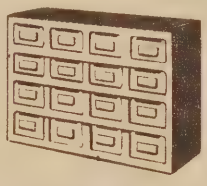

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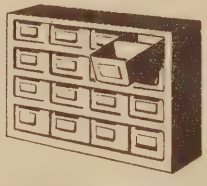

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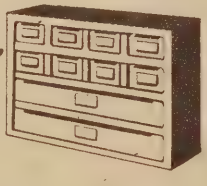

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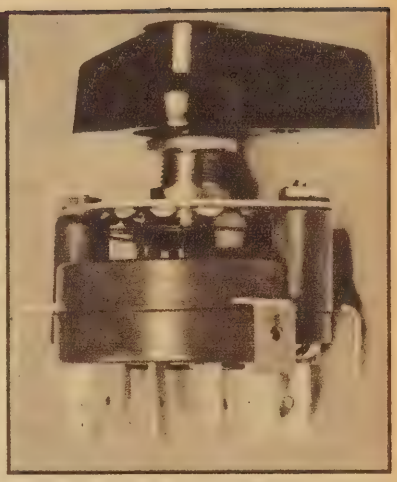
PATON ROTARY SELECTOR SWITCH

Breaking new ground in switch design, the latest Paton rotary selector unit should find many specialised applications.



AS shown in the photograph, the switch employs totally enclosed elements, thereby obviating dust problems.

At the same time, the contacts "make" and "break" in air, inside the high dielectric bakelite housing, thus avoiding deterioration due to heating and carbonisation of adjacent insulating materials.

The switch is also quite versatile in the possible arrangement of contacts, so that individual decks can be made up to 12-positions, 1-pole, 6 x 2, 4 x 3, and 3 x 4. Connecting links can be built in to minimise external wiring.

Up to eight decks can be provided on a single switch assembly.

Connections to the switch contacts can be arranged for soldering or push-on. Contacts are silver plated, contact springs are of stainless steel and the indexing mechanism of nylon. Other metal parts are rust-proofed.

The new switch is particularly recommended for use in air-conditioning equipment, washing machines, food mixers, battery chargers and space heaters. Rating is 10 amps at 250V AC.

Prices and technical data are available on application to Paton Electrical Pty. Ltd., 90-94 Victoria Street, Ashfield, N.S.W.

RESISTORS ARE CERAMIC ENCASED

Three types of high temperature resistors, rated at 5, 7 and 10 watts dissipation, form the latest addition to the IRC range.

PICTURED below, the resistors are encased in ceramic and are designed to work continuously at up to their maximum rated dissipation.

Of modest overall dimensions, the resistors are specially recommended for situations where the ambient temperature is likely to be high. Such situations may include sections of compact tele-

vision receivers and R/C filter systems in car radios.

The resistors are also well suited to use in dissipative bridges and attenuator networks, where stability under temperature is important.

Manufacturer's literature explains that the resistance element is wound on a glass fibre core, connecting leads are attached and the combination housed in a ceramic case. The assembly is bonded and sealed with an inert, non-inflammable compound, having a high thermal conductivity.

Technical data and resistance values are available on request from Wm. J. McLellan and Co. Pty. Ltd., 126 Sussex Street, Sydney.

MONTHLY NEWSLETTER

Continuing our Newsletter from the last issue; after a week admiring the beauties of ancient Rome and escaping death by inches many times from Italian taxi drivers, I spent an interesting month in Germany with our suppliers, highlighted by a week in the laboratories of Grundig, who are perhaps the largest of all German electronic organisations, covering every field from the cheapest portable radio to experimental atomic reactors, in which they are leading the field on the Continent in development and design, although no actual models are as yet in use.

My main interest with this firm was, of course, their industrial television equipment, instruments and domestic television and radio and I was amazed to see the progress in infra-red industrial television. One of the most demonstrative displays was to see a man in a completely darkened room with an infra-red camera trained on him shown as a perfect image on the TV screen; face, hands and exposed skin, as if televised from a well-lit studio, the clothing and the rest of the room being completely invisible. This is, of course, achieved purely by infra-red radiation from the body, using the most sensitive optical system and orthocon tube available and represents a fantastic advance in infra-red TV, as those who are up in this field will appreciate.

They are also developing new ideas and applications pertaining to remote control of miniature television cameras. Germany seems to be leading in the miniaturisation field, nearly all electronic firms having specific departments for the development of miniature industrial gear and airborne electronic equipment, etc. Examples here are a 38 pin plug and socket only ¼in in diameter and a DPDT relay hermetically sealed in glass, overall measuring ¼in. Also a complete unitary counter built as a plug-in unit for a computer, approximately 2¼in x 1¼in x ¾in, excluding the display tube. As representatives in this field of equipment, we shall be happy to supply additional information to those interested, for we are now in a position to obtain many items for specialised application.

In general, the enthusiasts of high quality sound equipment do not worry about buying separate amplifiers, pick-ups, etc., and assembling themselves, as the quality of sound from many models in the vast range of domestic equipment from such houses as Gratez, Loewe Opta, Braun, etc., is as good as can be obtained from the custom built hi-fi systems in Germany. There is a noteable lack of home builders and most large cities are lucky to have one shop where the amateur builder can buy components, most being trade only. Electrical shops abound, usually selling one brand only of each line, which is quite a change, and there are no discount houses (what a marvellous system!).

In an interesting week at the Graetz factory I inspected the brilliant new range of domestic television receivers and stereophonic radiograms and the considerable advances made in equipment for the 1960-61 releases, from which I slected a large shipment of their top quality models, which has already arrived in Melbourne, even before it has been released on the home market. These units will be on display at the Melbourne Ideal Homes Exhibition, alongside some new Grundig closed circuit equipment which will be feeding the TV receivers their program material. Happily, we will be in a position to offer immediate delivery of most items.

A host of new ideas show up here in everything from automatically opening doors on cabinets, automatic fine tuning, automatic channel selector, adjustable focus, automatic brilliance controlled by room light, etc. The cabinet designs, both contemporary and traditional, are built to take your breath away and include some brilliant new automatic features.

Whilst at Graetz I met the only Englishman holding a German amateur licence in the closed zone of Germany, which I believe is one of the hardest certificates to obtain on technical grounds. I would be happy to forward his name and address to anyone who would like to try and contact him.

Yours,

Phones—
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VICTORIAN TELE-SERVICE PTY. LTD.,
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Glenhuntly.

OFF THE RECORD — NEWS & REVIEWS

Since I arrived back in Australia about the middle of November, I have unfortunately been obliged to cope with a number of unpleasant things, including a spell in hospital recovering from an operation which a number of learned men decided could not wait. But during the last couple of weeks I have been up and about, and able to get back to my stereo set-up and a pile of records waiting for me.

by John Moyle

To say that I have enjoyed the experience after so long without it would be a gross understatement!

During my absence a friend with an obvious near-genius for cabinetmaking volunteered to build me a couple of special enclosures to house my two three-speaker systems and, true to his promise, they were waiting for me.

In fact, when I made a somewhat unsteady exit from the hospital, they were standing in the lounge room with all the speakers mounted in place and all I had to do was connect them up to the cross-over networks.

And that, I hear you say, is the kind of friend we all should have!

NOT FOR EVERYBODY

Now these enclosures are not the kind of thing I would suggest for everybody. To begin with they are each 4ft in height, more than 18in deep and 2ft across the front. They have a dignity and presence which impels respect; you know they are there, and to a large extent you must devote an entire wall to their placement and integration with the rest of the room.

But although, to date, I have not been able to do more than connect them up and get them correctly phased, they sound magnificent.

If you are lucky enough to have the room space, and the speakers, use something of this kind; there is no substitute, believe me. But don't think I am not well aware that they are an object lesson justifying the development of smaller enclosures for the average man!

Basically each is built around a vented enclosure of about nine cubic feet and housing a 15in bass speaker. The vent is actually a tunnel which extends toward the rear of the enclosure and over its full width, in an effort to provide phase inversion at a very low frequency, a requirement because the fundamental resonance of the speakers is only about 25 cycles.

"INFINITE" BAFFLE

Some of you may remember my preference for a completely enclosed box as against a vented enclosure because of its much smoother response curve.

Well, the idea was that, if I didn't like the performance of the enclosures, it would be a simple matter to cover up the vent from the inside, and thus convert them into infinite baffles.

But the necessary position in the room of the two stereo speakers means that I must abandon the corner which previously housed the single box and the new positions are not so good for the development of very low bass. I thought the extra radiation from the vents might be a good thing.

So far I have been enjoying what I now hear so much that I haven't developed the urge—or the energy—to commence experiment.

Listening to my pet test discs reveals that there is a high degree of efficiency in producing the bottomest bass, even if I fancy its definition isn't quite as good as with the infinite baffle.

But I'm a bit long in the tooth to jump to conclusions; I hope I may gather enough strength to arrange for some side-by-side tests with oscillator input, which will tell a much more accurate story.

In the meantime, one or two friends who have heard the speakers in action wonder what on earth I am worrying about!

The original intention was to house the middle and high speakers in a suitable pair of smaller cabinets arranged so that their radiation angle could be varied to observe the effect on stereo.

However, the cabinetmaker liked the idea of extending the sides high enough to make an upper compartment completely within the confines of the cabinets and, as I didn't object to the extra bulk, this is what he did.

The speakers themselves were mounted on a hinged baffle board so that its angle can be changed, but it didn't take me long to discover that I liked the results best when all speakers radiated from the vertical plane.

At the same time I think there might be considerable merit in avoiding the direct beaming of the upper frequencies by arranging their diffusion, but this effect is not obtained merely by allowing the speakers to radiate upward or at an angle in the Wharfedale manner.

Such a practice places you at the complete mercy of reflections from walls and ceiling and these are things not easily controllable in most cases.

Some device to insure omni-directional radiation from the speakers would be essential for this line of attack, but even this would not free you from the vagaries of reflected sound.

At any rate I found the stereo was much the best with all speakers radiating to the front, even if it did mean closer attention to listening position for best results.

And as for this, I have found that, even when not in the ideal position, stereo still sounds immeasurably better than mono no matter where you are, even when opening a bottle of Xmas cheer in the next room!

You don't have to be always pinpointing the source of every sound and checking it off mentally like a shopping list.

In fact, you won't really appreciate stereo until you can completely reject the gimmick mentality. Exact position isn't completely important, it's the difference in position that counts.

In fact this is the foundation of stereo listening, which is responsible for the extra sensation of breadth and depth in the source of sound.

CABINETS

Getting back to the cabinets, they are built of a mixture of heavy oak plywood nearly 1in thick and solid oak elsewhere, with liberal internal bracing to reduce resonance. The enclosures are lined with thick underfelt.

Either the twin 10- or 17-watt stereo amplifiers as described earlier in the year are used, and the control unit is the one designed for use with magnetic pick-ups. The pick-up itself is still the Ortofon which feeds the unit through two transformers.

And when I want radio, I switch to an F.M. tuner which plays through both channels.

Yes, thank you, it sounds fine!

Some comments might be of interest as the result of listening to this for a couple of weeks.

First of all the improvement I notice now that the two speaker channels are more nearly balanced is very great. Previously I was obliged to use a second speaker with a pronounced lift in the middle register as compared with the three-speaker system, and it was always a source of disappointment to me.

Now, although I suppose it is almost impossible to get two speaker systems to sound exactly the same, particularly when working from different parts of the room, I find the blend of sound very much smoother, with virtually no switching effects to one side or the other as a function of frequency response.

REASONABLY BALANCED

In fact I am at the stage where I can virtually reject the impression of listening to loud speakers at all. I just hear sound.

Secondly I am unable to detect any sensation of the hole-in-the-middle about which there is always some controversy raging.

This I think is because the speaker systems are reasonably balanced and free from obvious peaks, they are separated by the full width of the wall and turned slightly inwards in an effort to provide a polar diagram as even as possible, and they are correctly phased,

not only among themselves but in elationship with each other as a pair. It is quite true that some records give smoother and more cohesive "wall of ound" than do others, but this I am persuaded is not a matter of reproduction, it is inherent in the discs themelves.

For the most part, I can, as I have aid, quite forget that I am listening to wo speakers, particularly as I arrange hings so as to distract the eye from providing a visual division, and this impression has been borne out by all who have listened with me to date.

So much so that I am now inclined o be suspicious of schemes to introduce third channel by mixing splits from he two we have.

In a well laid-out stereo system, in which each speaker is providing correct or adequate coverage over the listening rea, I just don't think there should be he need for it.

If there is, and you are quite sure on his point, then I would first of all suspect the acoustics of your system and he placement of the speakers.

I would go so far as to suggest that he full impact of stereo as a domestic project depends on the blending of the wo speaker polar diagrams, and is likely to be degraded by the introduction of third synthetic channel.

Frankly, I don't quite know just how would go about adjusting such a channel, even if I had it.

In a very large hall, where the audience cannot all be accommodated in the ideal cross-over point of two polar diagrams, I can see the point of a multichannel system, but to me there is a fundamental difference in producing such a sound front and the simpler job of mixing two channels.

NO COMPLAINTS

I recollect, too, that in the last Conservatorium demonstration, no one complained of a hole in the middle.

This was largely due to the fact that I had two speakers at each side of the platform, and was able to angle one of each pair diagonally across the hall. But in so doing I was only making a deliberate modification to a single polar diagram, for the pairs of speakers were separated as far as I could get them, and each pair was placed side by side on the platform so that they radiated as nearly as possible from two single points.

Any attempt to do otherwise seriously degraded the stereo effect.

For the moment, therefore, I don't propose to go along with the idea of a third channel for home use. I want to be convinced that my own observations are wrong and, so far, every extra hour of listening tends to convince me that they are right, or that there is something wrong with my ears.

But if so, how is it that I hear such beautiful stereo? Modesty forbids me to supply an answer.

★ ★ ★

Most disappointing feature of my trip to Europe last year was the need to return home direct from London without going through with my schedule for England and America. I had a most interesting itinerary arranged and it would have allowed me to spend some time seeing and hearing the latest in the recording world.

Even so the long arm of coincidence brought some compensation. One of the men I had hoped to meet in England was Mr A. C. Haddy, recording engineer with the Decca Record Company, one of the industry's most experienced experts, a pioneer of the stereo disc with which Decca had been working intensively for many years before it was released.

Although the weather in Europe was phenomenally good through an abnormally late summer, the day I was to leave Geneva by air to catch the Qantas plane for London was so foggy that all Swiss airports were closed. Even oh the second day I managed to get out only through a train trip to Basle, whose airport was least affected by fog.

Among the handful of people in the same boat as myself waiting about Geneva airport was a genial, down-to-earth Englishman who seemed to know more about navigational aids and other electronic subjects than is expected of the average man.

You've guessed it; after mutually commiserating with each other, I found he was none other than A. C. Haddy himself, returning home after a visit to Geneva in connection with some recordings being made of the Suisse Romande Orchestra, and of Wilhelm Backhaus, who, despite his advancing years, is still performing and recording with distinction and popularity.

COMPARING NOTES

Mr Haddy, I found, had a ready response to enthusiasm and, particularly during the long train journey together on the second day, I had a grand time, comparing notes on recording experiences and listening to all he had to say technically, historically and musically.

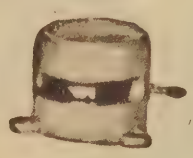
Like most down-to-earth engineers of his kind, he has a genius for calling a spade a spade, whether it relates to his own work or to that of others, and for that reason I hesitate to set down too much of what he told me, for I was in no sense interviewing him, and he is not a man who rushes into print.

His faith in the future of stereo is unbounded; here we were on common ground, and his enthusiasm for his latest tapes, not released yet, convinced me

The writer says:—

I am inclined to be suspicious of schemes which proceed on the firm assumption that a synthetic third channel is necessary for optimum listening.

In a well laid out stereo system, in which each speaker is providing correct or adequate coverage over the listening area, I just don't think there should be the need of it.



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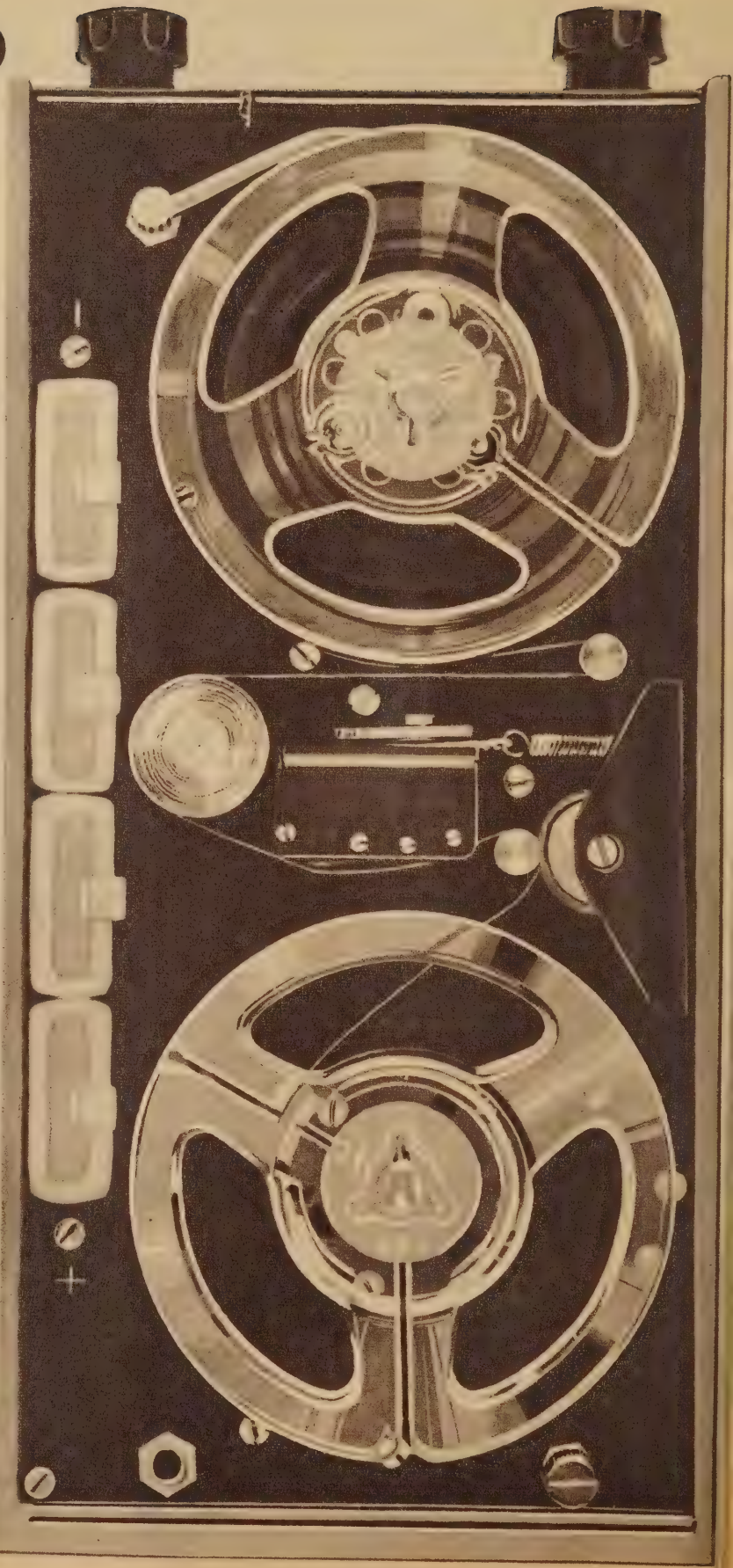

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hat they must be really something. He elieves that the coming of stereo has rought with it a complete technical evolution in the recording art.

He believes as I do that there has een no step in its history in any way omparable, for all improvements to date ave merely been extensions of what has een done before. But stereo added omething really new in sound, something hich has called for a total re-assess-ent of everything in recording, from coustics and mike placing to processing.

Decca's early work with stereo discs ncluded a method which required an ex-ension of response without distortion up o 30 kc, and the work done in achiev-ng substantial success with such a re-uirement was invaluable in producing he much less demanding discs as we ave them now.

He is particularly proud of the Decca ick-up, and his claims for it would ave sounded extravagant coming from nyone else and under different circum-tances. But a man who can so cheer-ully and immediately agree with criti-isms of his efforts, where these were ustified, must be taken equally serious-y when he talks about his successes.

ORDER OF DISTORTION

One point emerging from our talks, thought most interesting, concerns the elative degree of distortion inherent in modern disc due to the various pro-esses of its manufacture.

Speaking of the best discs made by is own company, and using the special ecording heads over which it has spent nuch time and money, Haddy says that he distortion due to cutting and process-ng is almost negligible.

This, of course, is a relative term, but e was prepared to say that the limits f distortion in his opinion were now ot with the disc but with the original apes, at least those running at 15 inches er second.

He did mention a figure of 2 per cent for tape, but as we didn't discuss whether this was an average, or a peak, or only achieved under certain condi-tions, I don't suggest it be taken too literally.

In support of his opinion, he went on to detail improvements in cutting heads, styli, and processing methods, none of which I feel I should discuss here, but which he intended to emphasise the big strides which had been made in over-coming the mechanical problems which most people have assumed would always limit the quality of disc records.

SUPERLATIVE PICKUP!

He was equally emphatic that only a superlative pick-up should be used to capitalise on these results, and here again he would come back to the essen-tial points in design — low effective point mass, pressures, resonances, etc.— which were needed to ensure perfect groove contact at all times.

I thought all this most significant in view of the constant controversy we hear about the relative virtues of tape and discs. It comes something of a shock to hear the tape itself blamed for the majority of disc distortion, given good processing.

This last, of course, is a pretty vital matter, and good though most of our ocal efforts are, it's clear that there s still a long way to go in eliminating surface noise, physical distortion due to pressing faults and so on.

Haddy would have liked to have seen the stereo disc in the laboratory for a couple more years before its eventual release. He isn't at all happy about some of the records which companies were forced to release when the dam broke.

I can sympathise with him in this, but isn't it always so? There never was a new development which was perfected before the first samples were for sale, from motor cars to aircraft.

And there is much to be learned from public use of the product which would almost certainly necessitate modifications to anything which has lived all its life in the laboratory.

The enormous growth of the stereo disc in so short a time does not indicate that the public has been disappointed with what it has heard to date.

And think of the fun that you and I would have missed!

★ ★ ★

Last month I had something to say about record clubs, or rather my quotation did.

I was much impressed on looking through my waiting batch of records to see that the World Record Club had lost no time in making the most of its recent deal with EMI and the purchase of many recordings from that company's standard list.

There is a most impressive array of famous names among them—Beecham, Sargent, Menuhin, Claudio Arrau and so on.

I'm sure this arrangement will do much for World Records, who were having a hard time of it to match the established labels in the quality of their issues.

WHETHER AVAILABLE

Whether the recordings made available to them will always do this I do not know, for there is still a wide plus and minus in the quality of the discs in the standard catalogue, even where the same artist or orchestra is concerned.

The discs World Record is releasing have probably all been issued previously by EMI, but not necessarily in Australia. Frankly I don't think this will matter much, as at the price they are all good buys, and that's the prime requirement for a record club.

Incidentally I think World Records should revise its lukewarm attitude to stereo. There is just no future without it, although it may be hard for any but the big names to issue discs of top quality. Time will tell.

RECORD REVIEWS:—

RACHMANINOFF — Concerto No. 3 for piano and orchestra. Played by van Cliburn and the Symphony of the Air conducted by Kiril Kondrashin (Carnegie Hall May 19, 1958) RCA SL16183 (Stereo).

This is a recording of an actual concert at Carnegie Hall which took place only two days after the pianist had returned from his successful tour of Russia, a tour which was to make him famous in his native America.

It is important to remember this, because many things about the recording are attributable to it.

In the first place the acoustics are not as good or as well balanced as they would have been in a recording studio. There are occasional coughs audible from the audience, and a great burst of applause which almost splits the final notes and which I found rather hard to bear.

But as David Sarnoff himself in a cover note points out it is intended to be a permanent document of a great occasion, and these things are all part of such a document.

The occasion itself has produced some very fine moments of performance and sound, despite the very limited amount of rehearsal which must have been possible.

In contrast to his powerful work in the Tchaikowsky concerto, van Cliburn displays considerable sensitivity and poetic feeling, both of which are required in abundance in this beautiful work.

To me his approach is an extremely youthful one. He is so much occupied with the poetry that he allows himself to extend it often beyond decent limits, and fails therefore to hold the music into its correct shape and proportion. This is a very dangerous procedure, and forces him into sudden dynamics the effect of which are so obvious that one wonders he was not instantly aware that he had traded weakness for romance.

On the other hand he does it so well that most people will find it easy to forgive him.

And of course I have a thing about Rachmaninoff which makes me rather a stern critic when I hear him underrated in a performance as though there was nothing to him but soft sentiment.

In this record I thought van Cliburn showed his merit as a pianist more clearly than in the Tchaikowsky. His work is far more subtle and many coloured, his ability to control his admirable technique is easier to see. As a performance I thought his was greatly superior to that of the orchestra, but those limited rehearsals might have had something to do with this.

The sound is reasonably good, with the piano sounding a trifle fuzzy strangely enough in some quite quiet passages.

But there is one significant fact — I liked it more the second time than the first, and that's quite a recommendation.

The stereo effect is not immediately obvious, not until, for comparison, one switches to mono, and notices immediately how much of the depth and atmosphere is lost.

★ ★ ★

BEETHOVEN—Piano Concerto No. 3 in C minor: Sonata No. 26 "Les Adieux." Played by Claudio Arrau and the Philharmonia Orchestra conducted by Alceo Galliera.

World Records TE201.

World Records have certainly secured a beauty in this one, originally recorded by E.M.I.

On one disc they have what could well be the best recordings of these works yet released.

Arrau is without doubt one of the most important pianists recording at the

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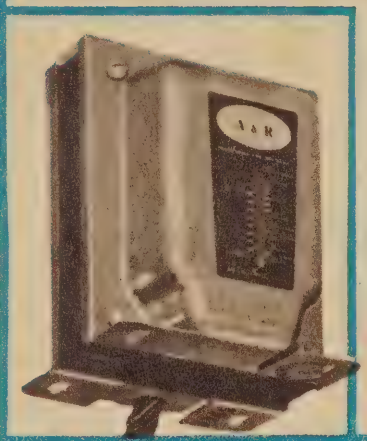

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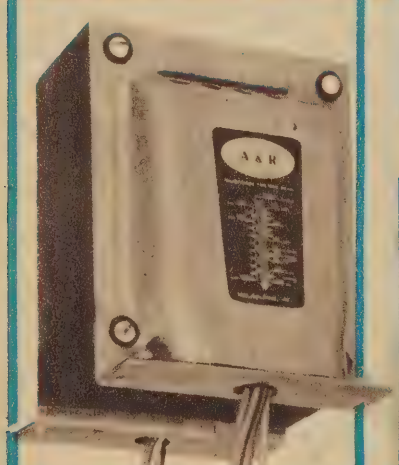

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1992	30	150-0-150	—	6.3v. 1.7a.
1993	50	225-0-225	—	6.3v. 2a.
1880	60	250-0-250	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a.
1881	60	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a.
1882	60	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a.
1883	60	385-0-385	5v. 2a.	6.3v. 2a.
1884	80	250-0-250	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1885	80	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1886	80	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.
1887	80	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1888	80	385-0-385	5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1889	100	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1890	100	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.
1891	100	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1892	100	385-0-385	5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1893	125	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a, 6.3v. c.t. 2a.
1894	125	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.
1895	125	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1896	150	250-0-250	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2a.

Type P. T.	D.C. mA.	H.T. Volts Per Side	Rect. Fil.	Other Fils.
1919†	125	300-0-300	6.3v. 1a. tap at 5v. 2a.	6.3v. c.t. 2a., 6.3v. c.t. 2.5a.
1927	125	385-0-385	5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1928	150	285-0-285	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1929	150	325-0-325	6.3v. 1a. tap at 5v. 2a.	6.3v. 2a., 6.3v. c.t. 2a.
1930	150	350-0-350	6.3v. 1a. tap at 5v. 2a.	6.3v. 3a., 6.3v. c.t. 3a.
1931	150	385-0-385	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1932	175	285-0-285	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1933	175	325-0-325	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1934	175	350-0-350	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1935	175	385-0-385	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1783	180	410-0-410	5v. 3a.	6.3v. c.t. 4a., 6.3v. c.t. 5a.
1936	200	285-0-285	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1937‡	200	300-0-300	5v. 2a.	6.3v. 3a., 6.3v. c.t. 3.5a.
1938	200	350-0-350	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.
1939	200	450-0-450	5v. 3a.	6.3v. 3a., 6.3v. c.t. 3a.

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present time, if indeed he is not, by and large, the finest.

Certainly I haven't heard the Concerto played more nearly to character for many a long day, and I have heard it played quite a bit.

Admittedly Arrau sounds a little tired—greater zest in the final movement would have lifted it immediately, for instance.

But his feeling for the music, his judgment of dynamics, his clear understanding of line and phrase are quite superb.

He is one of very few pianists who can mould themselves to Beethoven in this way, exhibiting virtually no mannerisms or conceits but showing a complete understanding of what the music intends.

The sonata if anything is played even more beautifully — a complete delight from start to finish.

The piano on the whole is recorded well, with a full round tone which Arrau produces so magnificently. The orchestra is adequate, and the acoustics of the hall are a little bit dry. The surface is good.

Club members would be foolish to miss this one.

★ ★ ★

THE COMPOSER AND HIS ORCHESTRA—Demonstration record by Howard Hanson and the Eastman Rochester orchestra. Mercury MG50175.

Here is something quite unusual, a record which will be of great value to anyone who is coming to grips with orchestral music for the first time, and, for that matter, of interest to any music lover.

We have had quite a few records in the past which displayed the various instruments of the orchestra so that their individual tone colours could be heard and recognised. Some of them have included music specially written so that the different sections of the orchestra are given special attention, and these are particularly valuable. One remembers Britten's "Young Person's Guide to the Orchestra" as being one of these.

In the disc Howard Hanson has done much more than this. He is, of course, a well-known conductor and composer in America and Europe, and if his works haven't achieved much fame many of them are extremely competently written.

His aim is not only to illustrate the tone quality of each instrument of the orchestra but to demonstrate how they sound as a team in their respective sections—strings, brass, woodwind, and so on—by playing sections from one of his own compositions, the Merry Mount Suite.

More than this, he has taken sections of the music and played first of all the parts taken by each section, finally bringing them together to show how his tone colour and texture was built up.

Thus the listener is able to think along with Hanson and appreciate just why each part was added as the composer explains what he was trying to do.

Finally the complete musical suite is played through, and it is most instructive to recognise the various selections which were used as examples as each one falls into place.

As a narrator Hanson is forthright, concise and informative, which at least enables him to get all his points clearly made in the time allowed.

Claudio Arrau

He has done his job extremely well.

Recording is first-class. I don't think I have ever heard a collection of sample instrumental sounds more true to label or more adequately displayed.

I liked it because it has set out with obvious sincerity to do a musical job without glamour or stunting and has succeeded admirably.

★ ★ ★

MY FAIR LADY—Musical numbers by the original cast, with Rex Harrison, Julie Andrews and Stanley Holloway. Coronet KLLS 1620 (Stereo).

When issued as a standard mono record some time ago this was a smash hit and has remained as the best ever issued on the subject.

And, as the seemingly endless procession of performances would indicate, people never seem to tire of listening to it.

They can start all over again with this stereo version.

With material such as this, where there are several voices and an orchestra to be accommodated, the ability of stereo to separate them, plus the authentic theatre spaciousness it has captured, really brings the whole thing to life.

And it's not merely a gimmick value resting on the fact that voices do separate.

Their individuality is very much more marked, they are easier to listen to and register in combination and contrast; they take on a semblance of life quite impossible with the single channel.

I completely enjoyed every minute of it, particularly the way in which the recording engineers have done their work without over-playing the stereo.

And the reproduction itself is first-rate, plenty of level and negligible surface.

Top grade entertainment.

★ ★ ★

STRAVINSKY—The Rite of Spring. Played by the Paris Conservatoire Orchestra, conducted by Pierre Monteux. RCA SL16086 (Stereo).

STEREOPHONIC EQUIPMENT

POINTERS ON BUYING

BE CAREFUL OF YOUR FRIENDS

Your friend may have read a few more advertisements than you have This does not make him an authority. Remain sceptical when he describes the X speaker as the only possible choice and has never heard it.

BE CAREFUL OF SPECIFICATIONS

One well-known speaker has a useful frequency range of 30-14,000 cycles in England and 20-24,000 cycles in America. One popular stereo cartridge has a frequency range of 40-12,000 cycles in England and 30-24,000 cycles in Australia.

DON'T BUY ON NAME ALONE

Remember there is as much difference between a 8in and a 12in in some of the good speakers as there is between a G.M. Holden and a G.M. Cadillac.

DON'T SPEND TOO MUCH ON YOUR AMPLIFIER

Though there is a difference between a good and a superlative amplifier, there is a far greater difference between a good and a superlative speaker.

DON'T TEST THE EQUIPMENT SOLELY ON DEMONSTRATION RECORDS

The number of persons who can tell the difference between a distorted and an undistorted train is very limited.

DON'T TRY TO BUY THE "BEST"

We don't know what it is and we have never met anyone who does. But with our wide knowledge of the equipment available and the music it is meant to reproduce, we can help find what is best for YOU.

TO HELP YOU MAKE YOUR CHOICE, WE CARRY A COMPLETE RANGE OF THE BEST EQUIPMENT OF ALL MAKES.

WE DO ACCEPT TRADE-INS

ENCEL ELECTRONICS

TRADE AND RETAIL SUPPLIERS

Enquiries — 354 Bridge Road, Richmond — JB2820

(5 minutes from Flinders Street)

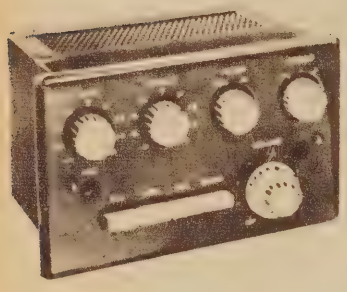
361 Bridge Road — Showrooms

For those who find evenings more convenient ring us and make an appointment at a time to suit you.

ROGERS AMPLIFIERS

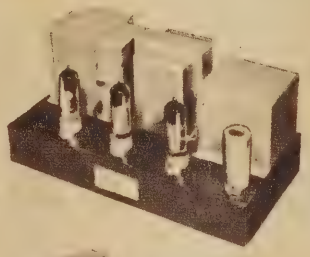
— FOR VALUE AND PERFORMANCE FAR AHEAD OF THEIR PRICE

STEREO:



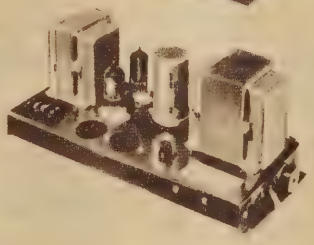
R D JUNIOR STEREO CONTROL UNIT

Incorporates every essential requirement for high fidelity stereo or monaural reproduction from tape, records and radio. An important feature is that dissimilar amplifiers may be used. Three position push button input selector. Ganged Bass, Treble and Filter controls. Price, **£48.0.0.**



R D JUNIOR AMPLIFIERS

Two R D Junior Amplifiers, connected with the R D Junior Stereo Control Unit, form the basis for the more ambitious Hi-Fi Stereo System. 14 Watts peak output. Harmonic distortion: ·12% at 10 Watts. Hum and Noise: -85 DB below 10 Watts. Price, **£41.5.0 each.**



R D CADET AMPLIFIERS

Two Cadet Amplifiers, again connected with the Stereo Control Unit, provide the ideal basis for the average Hi-Fi Stereo System. Peak output: 6 Watts. Inter-mod. distortion: 3·5% at 4 Watts. Hum and Noise: -72 DB below 5 Watts. Price, **£29.12.6 each.**

MONAURAL:

R D JUNIOR CONTROL UNIT

May be used with either R D Junior or R D Cadet Amplifier. Provides every worthwhile facility at a moderate price. Pick-up sensitivity: 5·9 m/V and 40-75 m/V. Four record characteristics. Radio input. Tape Record and Replay sockets. Bass, Treble and Filter controls. Price, **£27.15.0.**

R D CADET CONTROL UNIT

Inexpensive unit designed for Cadet Amplifier, mainly for use with crystal and ceramic cartridges. Pick-up sensitivity: 15 m/V or 75 m/V. Three record characteristics. Tape, Record and Replay sockets. Radio input. Wide range Bass and Treble controls. Price, **£20.10.0.**

Prices quoted are retail and fixed in all State capitals.

U.R.D.

175 Phillip Street, Sydney.
Telephone BW 3718, BW 3926

UNITED RADIO DISTRIBUTORS PTY. LTD.

UNITED RADIO DISTRIBUTORS PTY. LTD.
175 Phillip Street, Sydney.

Please send further information about the equipment illustrated in your advertisement,

particularly.....

To: Name.....

Address.....

.....

The Rite of Spring is not everyone's music. In fact, as the conductor of this record tells on the jacket notes, it caused a near-riot when he first presented it at the Theatre des Champs Elysees in 1913. Neighbours began to hit each other over the head with fists, canes, etc. The end of the performance was greeted by the arrival of the gendarmes. Stravinsky himself had disappeared through a window backstage.

Nowadays we are more used to the sound of such music, and even without the ballet with which it was first launched find little difficulty in appreciating the immense descriptive power of its stark genius.

As with all Stravinsky's scores, it contains many things to marvel at, particularly the amazing clarity and economy of the orchestration in which just the right musical impact is obtained with the fewest number of instruments.

This is largely the reason why the extraordinary atmosphere is created with such sharp and clean outlines, quite free from any superfluous undergrowth, so that we can follow each part if we wish to examine how it is done.

Such a work, with its free use of many instruments, is marvellous material for brilliant recording, and although there have been several such issued in the past none of them approaches this one.

By any standards, the quality of the playing is superb. Monteux is probably the most experienced conductor of this work in the world today, and he shows it in the subtlety of his treatment, a sharp contrast with several other conductors who are much more taken up with the dazzling possibilities of the sound.

Furthermore, the frequency response, instrumental presence and instrumental balance are all worthy of the highest praise. I can only suggest that you listen yourself to the bite of the strings, the authenticity of the brass, the sure registration of the woodwind, the hard, true quality of the tympani, and the stature of the bass.

This is a very high standard of recording.

But the real star of the disc is the stereo, without which most of these virtues would lose their bloom.

As I have said, it is essential to be able to distinguish each part in the score to appreciate fully what Stravinsky is doing, and the way in which stereo spreads it out before you is quite shattering.

In the final pages there are at least four orchestral sections playing separate and significant parts, all of which the stereo has accurately placed so that their individuality is complete.

On an all-round basis of achievement I don't think any stereo disc has impressed me more, and it gets my first stereo highest award.

Compared with the high amplitude and clarity of the record, the surface noise is negligible.

BRITISH COLOUR TV FOR CHINA

ONE of the latest British colour television cameras left the Hayes headquarters of E.M.I. Electronics Ltd. recently en route for China.

With the camera went control equipment and a Rank-Cintel large screen colour projector, which together form a complete closed circuit installation. It is the first colour television equipment to be exported to China by a British company.

Designed especially for a wide-range of industrial, medical and scientific applications, as well as for broadcast studio use, the colour camera incorporates several outstanding features.

The camera is of an entirely new British design, and uses three vidicon tubes and a novel optical system to give an improved quality even under difficult lighting conditions.

It carries a lens turret with four positions, and the optical system has been designed so that the maximum amount of light falls on the photo-conductive surfaces of the vidicons.

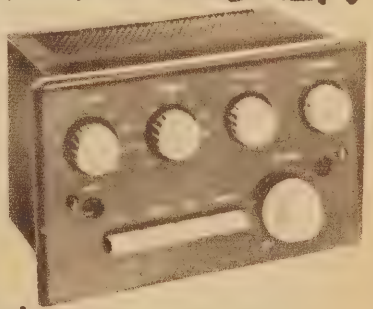
Notable for lightness and small size, it also has the advantage of being cheaper and easier to operate than the more elaborate Image Orthicon camera.

Capable of producing broadcast quality simultaneous colour television signals on either 405, 525 or 625 line standards, the camera is siutable for use in compatible television systems.

THE Edels SOUND
PTY. LTD. SPECIALISTS

✳ NEW RELEASE!
THE NEW ROGERS MARK II HIGH FIDELITY
STEREOPHONIC PRE-AMPLIFIER

only £48/0/0 | or £5 DEPOSIT 9/11 WEEKLY!



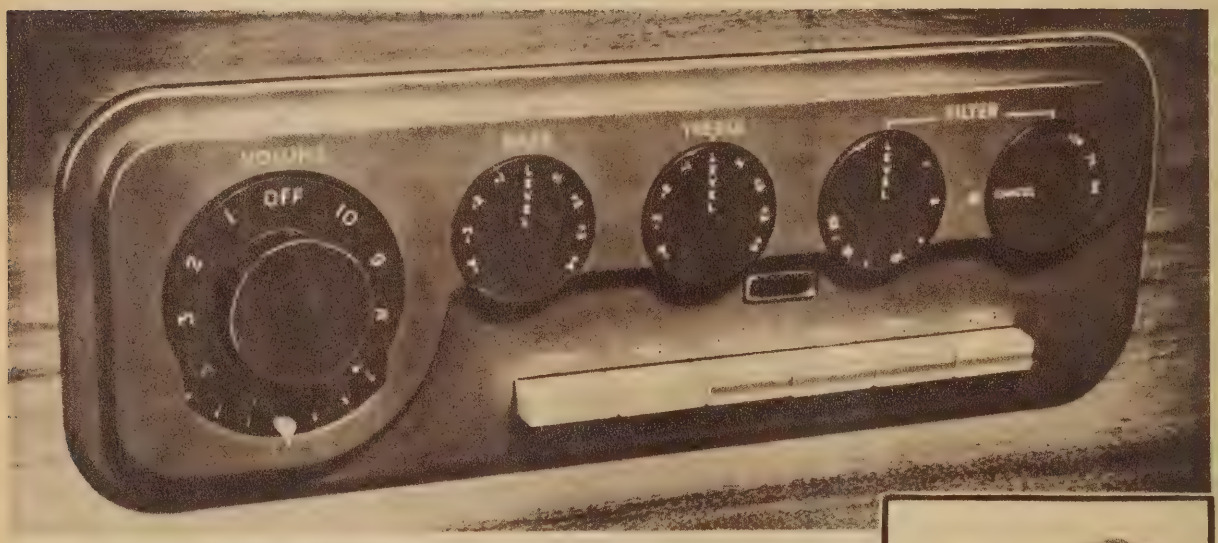
PUSH-BUTTON SELECTION
✳
FLAT OR R.I.A.A. INPUTS.

With these new features:
✳ Continuously variable low-pass filter 5 to 20 K.C.
✳ Guaged valume controls with separate balance control on Concentric Spindles.
✳ Improved tape and pick-up inputs.
✳ Built-in High Pass Filter.

This unit is suitable for converting crystal amplifiers to HiFi Magnetic Stereo.
YES! TRADE-INS ACCEPTED!

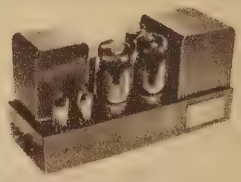
Edels PTY. LTD. 88 KING ST. BL1551

Control Panel of *World's Finest* Stereo amplifier



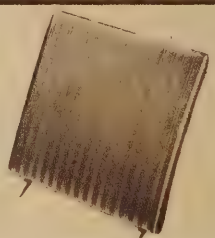
QUAD 22

Incorporating the newest design refinements and greater flexibility of input, the Quad 22 is designed for monophonic and stereophonic reproduction. Quad 22, the world's finest Control Unit, has separate volume and balance (for stereo) controls, bass and treble controls, filter slope and filter switch.
Quad 22 operates from radio and microphone, disc and tape, single track and stereo. Matching is provided for any pick-up.
Select input by depressing one or a combination of the four right-hand buttons, choose any of four play-back characteristics from gramophone, then listen to "the closest approach to the original sound." And remember, this magnificent achievement is from a unit similar in size to the Quad II Control Unit. Price: £64/15/-.



QUAD II Amplifier

Use one Quad II amplifier with your Quad 22 .Control Unit for monaural, or two for the finest stereo.
The finest amplifier in the world, the Quad II produces 15 watts of undistorted power throughout the range 20-20,000 c/s. Price: £61/5/-.



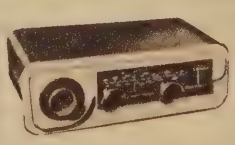
QUAD Electrostatic Loudspeaker

Completely distortionless reproduction in rooms from 1,000 to 5,000 cubic feet. This is not "spectacular hi-fi" — it's designed for completely natural, non-fatiguing "pure fidelity," so important to serious music lovers of all types. 70° optimum listening area. 45 c/s.-18 Kc/s. Price: £159/10/-.

F.M. Tuner

Operates in conjunction with Quad 22 Control Unit and amplifier through your hi-fi speaker system. Tuner indicator shows a tuning error of one part in 10,000. Extremely low distortion and high-noise rejection. Price: £61/-/-.

A.M. Tuner



Also operates through Quad amplifier and hi-fi speaker system. Response is incredible when the quality of its source is considered. Modulation frequencies up to 12 Kc./s. are accepted: Long and medium wave bands. Price: £61/-/-.

Prices quoted are retail and fixed in all State capitals.

British Merchandising PTY. LTD.

A B.M.P. Company

60 Clarence Street, Sydney. BX 1571

TECHNICAL BOOK REVIEW

USTRALIAN RADIO AMATEUR CALL BOOK. 1959-60. Published r the Wireless Institute of Australia the Victorian Division, W.I.A.

This latest edition of the Call Book, mpiled with the assistance of the Post-aster-General's Department, contains -to-date lists of call signs of the Aus-alian Amateur Service, including those Papua-New Guinea and Antarctica.

Other lists include: Prefixes and zones DX countries, QSL Bureaux — both ustralian and overseas', Television annels and services, Australian broad-sting stations. General information is ven concerning operation of amateur ations in Australia, first-aid and her useful topics.

Our copy from the Publication Com-ittee, Victorian Div., W.I.A. Austra-an price is 6/-.

★ ★ ★

ROM MICROPHONE TO EAR, by G. Slot. Hard cover, 258 pages, in x 8in, photographs, line diagrams nd circuits. Second edition. Published Philips' Technical Library.

This is the second edition of an ex-llent book first published in 1956. It rovides a complete survey, for the non-chnical reader, of the technique of ound recording and reproduction, to-ether with some first-class advice on me of the more technical problems en-ountered.

The advent of stereo in the past few ears has necessitated the new edition hich includes a special and extensive hapter on the subject. The remainder f the work has been revised and, where ecessary, brought up to date.

Interest in the reproduction, in the ome, of sound on record or tape, has oomed over the years since the war nd along with the boom has come a ewildering array of literature and ad-ertising matter often most confusing to he newcomer. Mr Slot covers the whole eld, as the title suggests, from micro-hone to ear, in a most satisfactory, lear and interesting manner.

Topics discussed include the cutting nd pressing of records, the operating rinciples and characteristics of pick-ps, the relationship between needle nd record, the care of records, record-layers, amplifiers, speakers, tape record-ng.

The section on speakers contains in-rmation, the operation and character-tics of the different types available, the coustical problems, multiple speakers, affles and enclosures, and finally the ffects of room acoustics.

Obviously, there is a limit to the mount of material one book can con-ain, but from a very wide field the uthor has selected and discussed most f the factors which ultimately affect he quality of reproduction and upon hich the choice of new equipment de-ends.

Our copy from Philips Electrical In-ustries, P/L, 69-73 Clarence Street. hilips House, Sydney. Australian price given as £1/7/6 (J.W.B.)

"PRINCIPLES OF FREQUENCY MODULATION". Applications in Radio Transmitters and Receivers and Radar, by B. S. Camies. Published for "Wireless World" by Iliffe and Sons Ltd. Size 8¾ x 5¼ inches, 147 pages, 87 diagrams. Stiff board covers.

Written primarily for students, radio engineers and radio amateurs, this book sets out to give an overall picture of the FM system, in as much detail as is possible within the space available to the author.

The first three chapters are in the nature of basic theory, covering the history and features of FM as a system, the theory of operation and a quite lengthy discussion of the FM signal in relation to interference of one type or another.

In chapter 4, the author discusses the generation of frequency modulated signals followed, in chapter 5, by a corresponding discussion of the methods of detection.

Chapter 6 is devoted to FM receiver design, each of the "front-end" sections coming in for individual discussion.

The author stresses the necessity for meeting certain basic requirements in the overall design and that failure to do so, as evidenced in some early commercial receivers, can cause the system to be discredited. In this connection he points out the limitation of too-small aerials.

The final chapter is entitled "Non-Broadcasting Applications Of Frequency Modulation," the title being more or less self-explanatory.

In presenting all this material, the author has endeavoured to follow a middle course in relation to relevant mathematics. Enough formulas and expressions are included to lend substance to the discussion, without making it entirely dependent thereon.

Our copy of the book came direct from the publishers but local booksellers should have supplies by the time this appears in print. (W.N.W.).

★ ★ ★

FREE BOOKLET

ANOTHER free booklet has been released by the Amalgamated Wireless Valve Co. Pty. Ltd., of 47 York Street, Sydney.

Titled "A.W.V. Transistor Glossary" it is basically a reprint of material which has appeared in their journal "Radiotronics."

It contains six pages of terms, arranged in alphabetical order, relating to semiconductors, and should therefore be quite useful to anyone wishing to bring their terminology up to date.

The book is available free on application and is post-free.

IMPORTANT NOTICE TO RECORD COLLECTORS.
I can take orders for overseas INDENT RECORDINGS. Also HARD-TO-GET "STEREOPHONIC RECORDINGS." And all local Aust. Releases. COLLECTORS' RECORD IRELAND. Deposit of half on all orders.
Place your orders with
M. T. BOVINGTON,
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Ironcore Quality Components
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21 inch TELEVISION RECEIVER

POWER TRANSFORMER
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MATCHING FILTER CHOKE
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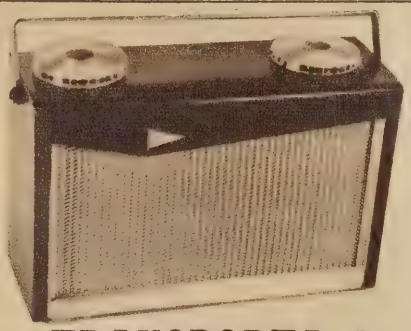
MAKING A TRANSISTOR PORTABLE?



TRANSPORTA 4

Complete Kit of Parts for Transporta Four as Featured in October Radio and Hobbies, including Cabinet as used with the Transporta,

£16-17-6

Plus Postage.
LESS CABINET, £14/7/6.

Most parts used in the Transporta Four can be used for the Transporta Seven should a larger set be required at a later date.

NEW 6V RECORD PLAYER, £7/15/-

These new 4-speed Record Players are supplied with turnover crystal pick-up and sapphire needles, and are suitable for use with the above or any transistor ratio.
Postage and packing extra.
N.S.W. 10/; Interstate 15/-.

COMPLETE KIT OF PARTS for the TRANSPORTA SEVEN

£26/17/6 SET WIRED AND TESTED £2/10/- EXTRA

Complete kit of parts for the Transporta 7 as featured in Radio and Hobbies, including 7 S.T.C. Transistors, Printed Circuit Boards, Coil Kit, Rola 5F Speaker and Transformers and all necessary parts to complete this set including attractive and durable two-tone cabinet with gold trim. Fitted with special aerial coil and plug to connect to your car aerial or external aerial making it an ideal car set or for use in the country.

POSTING AND PACKING EXTRA on transistors 4 or 7 sets. } N.S.W., 15/-. INTERSTATE, 22/-.

R.C.S. TRANSISTOR PORTABLE

COMPLETE KIT OF PARTS INCLUDING BATTERY AND FULL INSTRUCTIONS.

Cream cabinet. **Dimensions: 6½in x 4in x 2.**

£19/15/0

Post: 7/6 extra.

TAPE-RECORDER MOTORS

New Collaro Tape Recorder Motors, 240 volt, A.C. Adaptable for many uses.

37/6 Post extra.

CONDENSER SPECIALS

Boxes of 100 new ceramic, mica, paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, 1. Also 500 mfd/12v., 10 mfd/40v., 16 mfd/350v., electrolytics.

25/- per 100.
Post Extra: N.S.W., 2/6: Int., 3/6.

CONDENSER SPECIALS

100 new mica paper and ceramic condensers, mixed values.

15/- Post 2/.

NEW I.R.C. RESISTORS

I.R.C. carbon resistors, ½, 1 and 2 watt, in values 5 ohms to 5 meg., including many popular sizes. 3T, 15T, 20T, 50T, 100T, 250T, 500T, etc.
(Standard resistor colour code supplied.)

100 for 25/-. Plus 1/6 postage.

NEW METER RECTIFIERS

Westinghouse 1 mA rectifiers, 15/.

ELECTROLYTIC CONDENSERS

New Dubilier pigtail condensers.

8mfd 600V 3/9
16mfd 600V 5/9

Post Extra

DYNAMIC SPEAKERS

New 7in Dynamic Speakers.
1500 ohm. Field, 25/.
5T or 7T trans., 10/- extra.
Plus postage.

NEW 4in PER-MAG SPEAKERS

5T or 7T Trans.

25/-

Post and Packing, 3/6.

HIGH IMPEDENCE HEADPHONES. NEW 27/6.

Post 2/6.

STANDARD INTERMEDIATE FREQUENCY TRANSFORMERS

455Kc, 1¼in square can. Slug tune.
4/9 post extra.

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping. Sec. 285. x 285 with 6.3v filament winding 60mA.

25/- Plus postage, N.S.W. 3/6, Int., 5/3.

NEW MIDGET POWER TRANS.

40mA prim., 250v. Sec. 225 x 225 with 6.3v Fil. Winding Upright or Flat Mounting. Size 2in x 2½in.

25/- 2/6 Postage, N.S.W., Interstate, 4/6.

30mA 240v Prim. 150 x. 150v. Sec. with 6.3 v Fil. Winding.

22/6 Postage: N.S.W., 2/6 Interstate, 3/6.

MICA CONDENSERS

Standard Mica Condensers, small current types .00003 and .005, including most wanted values.

10/- Postage 1/6. per 100.

CARBON RESISTORS

New carbon resistors, mixed values. Well-known make. **10/ per 100. Post free.**

NEW POTENTIOMETERS

with SWITCH STANDARD SPINDLE	WITH SWITCH SHORT SPINDLE	LESS SWITCH STANDARD SPINDLE	LESS SWITCH SHORT SPINDLE
25,000 ohms 100,000 ohms 500,000 ohms 1 meg. ohm 4/6 ea. 42/ doz.	100,000 ohms. 500,000 ohms. 2/6 ea. 24/ doz.	100,000 ohms. 500,000 ohms. 3/6 ea. 33/- doz.	50,000 ohms. 100,000 ohms. 500,000 ohms. 1/9 ea. 16/ doz.

500,000 ohm pots can be supplied tapped at 40,000 if required, post extra.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. Phone LM7398

SPECIAL PURCHASES!

New 5 Valve Dual - Wave Radiogram Chassis

THESE NEW DUAL WAVE RADIOGRAM CHASSIS MADE BY LEADING MANUFACTURER ARE EQUIPPED WITH LATEST MINIATURE VALVES AND SUPPLIED WITH 12in ROLA SPEAKER.

£16/15/- F.O.R.

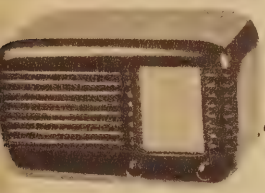
PACKING 10/- EXTRA

NEW 4 SPEED COLLARO CONQUEST RECORD CHANGERS

THESE NEW 4 SPEED RECORD CHANGERS ARE EQUIPPED WITH HIGH FIDELITY CRYSTAL PICK-UP AND SAPPHIRE NEEDLES. CAN ALSO BE USED AS A MANUAL PLAYER.
SUITABLE FOR USE WITH ABOVE RADIOGRAM CHASSIS.

£10/15/- F.O.R.

MAKE UP THE "LITTLE GENERAL"



£12/17/6

Complete kit of parts for the 1957 "Little General" as featured in R. and H., including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F Speaker and kit is complete to the last nut and bolt. (Set wired and tested. £2/15/ extra.)

Cabinet size, 11½in long, 7in high, 6in deep. Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly .. 57/6

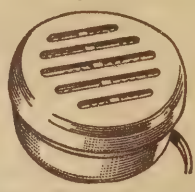
Post and Packing: N.S.W., 14/6 Interstate, 25/-.

NEW RECORD PLAYERS

4-speed B.S.R. Player with Turnover Crystal Pick-up and Amplifier in attractive Two-tone Cabinet.

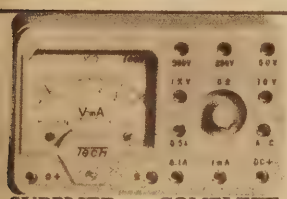
£18/15/- F.O.R.

PILLO-FONE EXTENSION UNIT



IT'S A REAL MINIATURE WITH ROLA UNIT

Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED.
3½in Diameter by 1¾in deep.
POST FREE. **22/6**



SUPPLIED COMPLETE WITH TEST LEADS

NEW MULTIMETERS – 67/6 POST EXTRA

METER O-IMA 1000 OHMS PER VOLT

A.C. RANGES	D.C. RANGES	CURRENT RANGES
0—10v	0—10v	0—1MA
0—50v	0—50v	0—100MA
0—250v	0—250v	0—500MA
0—500v	0—500v	
0—1000v	0—1000v	

OHMS RANGE 0-100,000 OHMS.

NEW 12in PER MAG SPEAKERS

These Standard Speakers by leading manufacturer (we cannot advertise the make) are supplied less transformer.

47/6 Packing extra.
Post, N.S.W. 10/-; Interstate 12/6.

9in x 6in OVAL SPEAKERS

37/6 Post, N.S.W. 7/6; Interstate 11/6. Plus packing.
Transformers for above speakers 5,000 or 7,000 ohms, 10/-.

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt, at 4 amp, 37/6
Post, N.S.W. 7/6; Interstate 10/-.

Transformer for above rectifier tapped for 6 or 12 volt, with circuit for charger, 47/6
Post, N.S.W. 7/6; Interstate 10/-.

NEW VALVES AT BARGAIN PRICES

6J6 .. .. 12/	6K8G 9/6	1C7G 3/	6SL7 .. .. 10/6	6X6S VRSS 5/
ECH 35/VR99A, Direct replacement for 6J8G 10/	6SJ7GT 9/6	1K5G 2/6	6H6GT 2/6	6J6 .. .. 12/
1C4 .. .. 7/6	12K8 .. .. 10/	1M5G 3/	6K7GT 7/9	6V6GT 12/6
1T4 .. .. 4/6	EK32 .. .. 10/6	1K7G 3/	6U7G 5/	VR65A 2/6
1S5 .. .. 10/	6SA7GT 9/6	1L5 .. .. 9/6	6J7G 5/	41 .. .. 7/6
3S4 .. .. 10/	6SH7 .. .. 5/6	6C8G 5/	7C7 .. .. 3/6	7193 .. .. 3/6
1R5 .. .. 10/6	105G 4/	6S87 .. .. 8/6	78 .. .. 7/6	12A6 .. .. 7/6
1A7GT 9/6	1P5G 2/6	6H6 .. .. 2/6	EL32 .. .. 10/6	EF50 .. .. 2/6
1D8GT 9/6				12SH7 .. .. 5/
6A8G 10/6				6K7G 4/6
6AC7 .. .. 3/6				1C6 .. .. 7/6
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VARIATION IN FIELD DAY RULES

The WIA's 1960 Australian National Field Day Rules have been varied to provide attractions for all amateurs. Groups in the field should enjoy operating away from electrical and other noises for a weekend.

NATIONAL Field Day Events are particularly well supported overseas but have never been very popular in Australia. No single event since their inception nearly 25 years ago here has received what could be considered reasonable support.

The attraction of outdoor amateur operating does not apparently appeal to the VK gang; perhaps they see enough of parklands, hills, etc., during their normal excursions.

Overseas, with winter snow perhaps, there is some impetus to dash out after the hibernation of the cold months. In the RSGB 1959 event, no less than 101 amateur club or section groups set up equipment and operated in that contest.

GOOD SUPPORT

Support for the 1959 A.R.R.L. Field Day was greater than ever before with over 13,000 amateurs actually participating. As usual for K/W, station equipment and the portable gear was often complex.

Sometimes six transmitters were operated simultaneously from a single site using multi-band beam structures. Often groups used up to 25 operators and 7 kw generators as power source units. Quite a number of stations were used to make over 2,000 contacts during the event.

The WIA's Federal contest committee have made special arrangements to ensure the 1960 VK National Field Day is as attractive as possible.

A section has been added for fixed stations and the all night session on the Saturday night has been eliminated. More time has been allowed for packing up and returning home on Sunday.

As the rules now stand, it is possible for every amateur to participate whether at home or in the field. The event has many attractions and the committee has made every endeavour to popularise the event this year.

THIS YEAR'S RULES

The rules for this year's event are as follow:

Date: Saturday and Sunday, February 13 and 14, 1960.

Duration: Saturday, 1800 to 2300 hours, and Sunday, 1000 to 1600 hours E.A.S.T.

Objects: The operators of portable and mobile stations within the Commonwealth and Mandated Territories will endeavour to contact other portable/mobile and fixed stations.

Rules:

1. There shall be five sections to the contest.

(a) Portable/Mobile Transmitting Phone.

(b) Portable/Mobile Transmitting C.W.

(c) Portable/Mobile Transmitting Multiple Operators, Open only.

(d) Fixed Transmitting Stations working Portable/Mobile Stations, Open only.

(e) Reception of Portable/Mobile Stations.

2. All Australian amateurs may take part. Mobile or Portable Stations shall be limited to an input of 25 watts to the final stage. This power shall not be derived from any public or private mains.

A Portable/Mobile Station shall not be located within a radius of one mile from the home(s) of the operator(s) nor shall be located in any occupied dwelling or building.

Portable/Mobile Stations may be moved from place to place during the contest.

No apparatus shall be set up on the site selected earlier than 24 hours prior to the contest.

All amateur bands may be used but no cross-band operation is permitted.

3. Amateurs may enter for either (a) or (b) or both in the Portable/Mobile Sections.

4. One contact per station for phone and one for CW per band shall be permitted.

5. Entrants must operate within the terms of their licences and in particular observe the regulations with regard to portable operation.

SERIAL NUMBERS

6. Serial numbers consisting of the R.S. or R.S.T. Report plus three figures commencing between 001 and 100 shall be exchanged.

7. Scoring:

(a) Portable/Mobile Stations:

For contacts with similar stations outside entrant's call area—15 points.

For contacts with similar stations within entrant's call area—10 points.

For contacts with fixed stations outside the entrant's call area—5 points.

For contacts with fixed stations within the entrant's call area—2 points.

(b) Fixed Stations:

For contacts with Portable/Mobile Stations outside entrant's call area—15 points, within entrant's call area — 10 points.

8. The following shall constitute call areas: VKI (A.C.T.), and VK2 combined, VK3, VK4, VK5, VK6, VK7, VK9 and VKO.

9. Logs—all logs shall be set out under the following headings: Date/Time, Band, Emission, Call Sign, RST/No. sent, RST/No. received, Points claimed.

In addition there shall be a front sheet showing the following information—Name, Address, Call Sign, Section, Call Signs of other operators (if any), Location of Portable/Mobile Station and hours of operation, a brief description of the gear used, bands used, points claimed.

A declaration must be provided stating the rules and spirit of the contest have been observed.

10. The right is reserved to disqualify any entrant who, during the contest has not observed the regulations or who has consistently departed from the accepted code of operating ethics.

11. The decision of the Federal Contest Committee of the W.I.A. is final and no disputes will be entered into.

12. Certificates will be awarded to the highest scorer in each section in each call area.

Return of logs: All entries must be post-marked not later than Saturday February 28, 1960, and addressed to the Federal Contest Committee, W.I.A., Box 371B, G.P.O., Hobart, Tasmania.

Receiving Section: The rules are essentially the same as for the transmitting section.

Logs shall take the same form as for that section but will omit the serial number received. Logs must show the call sign of the station heard and the serial number sent by it and the call sign of the station being worked.

Scoring will be the same as for transmitting stations. A station may be logged once only for phone and once only for CW in each band.

Certificates will be awarded for the highest scorer in each call area.

Too many contests?

The holding of so many DX Contests has been a subject of much comment. Main reaction is directed against contests as a source of QRM when only supported by a small minority of the DX fraternity. Although the number of amateurs have approximately doubled in the last decade support for DX contests has not increased but rather fallen away.

Some suggestions for the cutting of QRM include the restriction contest operation to a portion of the bands.

Only a section of the DX operator are contest minded but invariably many get literally dragged into contests or suffer interference from "CQ contests" etc. Other views expressed include the restrictions of contest sessions to not more than 24 hour periods preferably split into two with a reasonably rest period in between. Also to spread out events over the year by IARU arrangement.

Other ideas include making all contests of international interest (all amateurs irrespective of where they are located may compete).

Keep the rules simple and in close populated areas restrict contests on DX bands to two per year. Don May, G2BI offered much of the above comment. G3BID in a rather liberal estimate of activity in one world wide contest calculated that no more than four per cent of operating DX amateurs participated.

Certainly hardly sufficient to warrant the tieing up of DX bands for 60 hours over two weekends. Inspection of the logs submitted for most DX contests show a falling off in recent years.

Only nine logs in the CW section and one in the Phone section were listed from VK stations in the 1959 ARRL DX contest results. Ideas on the subject will be varied but many amateurs hold firm convictions that some limiting of DX contests must be made to ensure the most effective use of the available bands for international working.

Geneva note

Region 11, which includes North and South America, the Western Atlantic and the Pacific Ocean to Hawaii, amateurs suffered no changes to their bands below 220 MC/s.

In the bands above 220 MC/s the only change is 3300-3500 MC/s in lieu of 3500-3700 MC/s. The 11 metre band is still provided for and Canada and other countries will probably still enjoy the privilege of operating.

The band was lost to Citizens Radio in the U.S. some time ago. Amateurs in Region I and III did not do so well. Amateurs throughout the world await with interest and some apprehension the final Frequency Table from Geneva.

It is hoped that one of the results of the Geneva I.T.U. Conference will be the clearance of the multitude of commercial and other intruders from the exclusive amateur sections of our bands. With smaller allocations this will be very necessary if we are to make full and effective use of the available frequencies. Interference will be bad enough on 7 M/cs without additional signals from other sources.

Recording "intruders"

For some years now a group of British amateurs under the auspices of the R.S.G.B., have been ardently recording the call signs of all intruders on our bands. In Europe the 7 M/c band especially, has been under constant pressure especially from Continental broadcast stations. This is very apparent when checked by a few hours listening on the band in the early morning. Similar schemes have been sponsored here in Australia by the W.I.A.

Most of the monitoring stations average four to five hours listening each week. A number even operate up to 10 to 12 hours a week.

At the end of each three months, log sheets are forwarded to the Honorary organiser of the watch who summarises the information for the R.S.G.B. Finally the society sends the details to the G.P.O. An attempt is made to filter out obvious receiver image reception reports and stations that are heard only once. The latter are listed and included in further reports if heard again.

Full details of transmissions are logged and frequencies recorded to plus or minus 1KC or better.

Limitations of the scheme include difficulties in proof of identification of intruder stations, jammers who themselves are intruders, and the lack of equipment to monitor teletype, high speed morse and facsimile. Despite these problems much useful work is being performed. Operating in the exclusive 7,000 to 7,100 Kc/s segment are a number of high-power B/c stations, including Pakistan, Spain, Cairo and Peking.

With few exceptions such as transmissions by countries for their nationals overseas, most of the material broadcast is propaganda and counter-propaganda.

It is difficult with all the jamming and interference to obtain much pleasure from short-wave broadcasts or little information for that matter.

The work is under the control of G3ADZ as Honorary Organiser of the R.S.G.B. Intruder Watch. It is hoped his task will not be so arduous when the Geneva I.T.U. Frequency Table arrangements are finally implemented.

Radio clubs

One U.S. Radio Club adopted novel means in their endeavour to place news of the club's working before the general public and to provide guidance to youngsters interested in the hobby.

The main method of approach was to provide each of the public and High school libraries with a book explaining amateur radio and its operation.

On the fly-leaf of each book the names and phone numbers of amateurs in the area were listed with an invitation to contact them for further information on amateur radio.

A publicity campaign was also carried out in the local press. It was not long before phone calls started to come in and 80 new members were acquired. The next move was the formation of an evening class on radio for which a charge was made. A batch of 15 new amateurs was on the air in six months.

One of the major difficulties, expecially in country areas, is for budding amateurs to contact active operators, although in recent years many new clubs have been formed.

Publicity via High schools is being carried out in some districts but further activity in this sphere would be valuable.

A donation of a subscription to a suitable journal or handbook would be a good method of starting youngsters in High schools along the road to amateur radio.

W.A.S. award

Applications for the ARRL's W.A.S. Award must now submit 50 cards from all U.S. States.

Hawaii makes the 50th State. Actually cards for 49 States exclusive of Hawaii will be accepted for the award until March 15, provided all contacts were made prior to August last. To Australians, Hawaiian contacts would provide no problem so 50 cards would be sent. The award requires that cards must show satisfactory evidence of two-way communication.

They should be forwarded direct to the ARRL.

In the VHF sphere, 73 American and 1 Canadian stations have completed a W.A.S. on the 50 Mc band. Seven of them have made the 49 State grade. Most of the awards were granted before the elevation of Alaska and Hawaii to Statehood.

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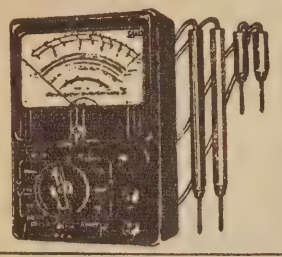

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Complete with batteries and test leads.

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High sensitivity 40 micro amps, full-scale meter measures:—
AC Volts 0-10V, 50V, 250V, 1,000V (8,000 ohms V); DC volts 0-10V, 50V, 500V, 1,000V (20,000 ohms/V) D.C. current 0-50 micro amps, 2.5mA, 25mA, 250mA. Resistance: 0-5k, 50k, 500k, 5meg. Decibels: 0db-122db (AC 10V range), 0db-0.755V, 600 ohms. Special range for DC 5,000 volts. Complete with batteries and test leads.

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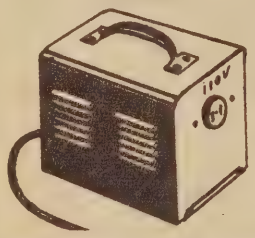

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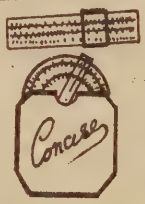

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No. 403, with magnifying cursor, in leather case, length 4½in.
PRICE, 39/6.
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No. 28 Concise (circular) 3in diam. in plastic case. Price 25/-.

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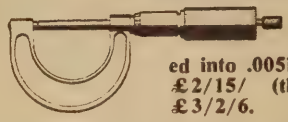

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MORSE KEY

Sturdy army type, with variable movement.

Price 7/6. Post 3/6.

NEW VOLT and AMP Meters

0-50	AC/DC	3½in round	55/-
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0-3 amp	AC/DC	3½in round	55/-
0-20 amp	AC/DC	3½in round	55/-
0-30 amp	DC	3½in round	55/-
0-50 amp	AC/DC	3½in round	55/-
0-50 amp	DC	3½in round	55/-
0-100 amp	AC/DC	3½in round	55/-
0-1 Milliamp		1¾in square	37/6
0-50 Microamp		1¾in square	70/-
0-100 Microamp		1¾in square	50/-

Postage 6/- ea.

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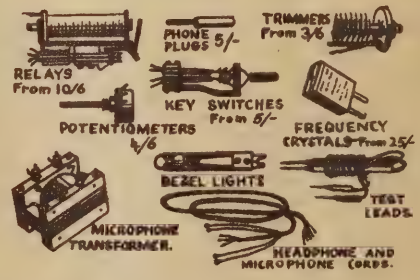

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Mobile in the U.K.

An indication of the frequencies used n the U.K. for mobile operation work-ng is provided in an analysis of the equipment on show at Mobile Field Events. At one particular rally when 300 mobile stations were assembled, 45 per cent used Top Band 160 metres, 25 per cent 144 M/cs, and 15 per cent 80 metres. These figures hold for other similar events. Attendances at mobile rallies peaked at over 1,200 dur-ng 1959 with the 1,000 mark reached on a number of occasions.

Talk-in stations were normally pro-vided on 160 and 80 metres and 144 m/cs. Equipment competitions are held at these events and prizes awarded for such events as the best complete in-stallation, the most original aerial sys-em, safest mobile installation, etc.

The Top Band is particularly popu-ar in the U.K. and annually the R.S.G.B. conducts a contest on the band, an event always well supported. Both this band and 3.5 Mc/s can be used throughout the year and do not suffer from the heavy static levels common here in summer.

Transatlantic on 144

Discussions are still taking place on the possibilities of a transatlantic contact of 144 Mcs. It is a source of wonder to many of the K/W's that such a con-tact has not already been made. Unfor-tunately Europea amateurs operate under some difficulty with limited power, etc.

Irish VHF specialist EI2W is ready to carry out extensive tests this year to attempt to brige the Atlantic. He is hopeful of success. W2TTM is looking for a European partner for such work-ing.

He is well equipped and in a good location for west working. Uses just on a kw with 78 efficiency and feeds a pair 24ft 13 element yagis.

G3HBW is co-operating with W3CXY but to date no contact. The success of W6NLZ and KH6UK in setting up world records on 144 and 220 Mcs of 2,540 miles was in no small part due to the effective use of their 14 Mcs liaison circuit. This feature eliminated searching when the other station was not transmitting, they were always active only when the VHF transmitters were operaing.

Similar arrangements are being incor-porated in these tests and should assist in the ultimate bridging of the Atlantic on 144 Mcs.

An interesting insight into how VHF conditions do vary is provided these days by the variation of TV signals at dis-tances of 100 miles and more. For days in some locations little or no signals appear then under suitable propagation conditions for hours on end viewing could be compared with those of sets in the suburbs.

It only shows what additional paths could be covered by amateurs on the VHF's if they had sufficient time and equipment. The old Rhombic provided some of the best pictures in locations on the south coast of N.S.W. at dis-ances of nearly 200 miles.

50 Mc note

The station worked by VK6BE on 50 Mcs mentioned in the December issue was 9M2OQ in Malaya, not GM2OQ as published. The 9 must have looked like a G in the original text. A contact with Scotland would have certainly shattered the critics but it was not to be.

Most of the VHF enthusiasts were active in the Ross A. Hull Memorial Trophy Contest and a number of good openings occurred interstate in Decem-ber. JA's were also worked by VK3, VK5, VK7 and, of course, VK4 during the month.

Jock White, ZL2GX, reached the top again in the ARRL DXCC. He is with Don Wallace, W6AM, with 296 coun-tries confirmed. Close by are WIFH and W8HGW with a total tally of 285. It is quite a race to the 300 countries mark, new prefixes are running out fast and the DXCC leaders are dependent on DX-peditions to increase the list.

Seventy-one different amateurs in W/K, ZL, PY, G, KV4, CE, ZS6, LU6 and VK have 280 or more countries confirmed.

Arthur Stowar, VK2ACX is the only VK represented in the list with 280 con-firmed.

U.S.S.R. calls

U.S.S.R. amateurs operating on the HF bands use the well-known letter U as the first letter of their prefix. On the VHF bands this is substituted by the letter R. The Russians apparenly con-sider 27.5 Mcs as the frequency where HF bands become VHF bands. As a re-sult such calls as RH8ABC and RAIHP are appearing on the 28 Mcs band in-stead of the usual UH8 and UA1, etc.

Extra facilities

The British G.P.O. has granted G amateurs permission to use Radio Tele-type (RTTY) and Facsimile. RTTY may be used on all bands with the exception of 1.8 to 2.0 Mcs and Facsimile on all bands above 420 Mcs. The number of radio amateurs in Great Britain reached nearly 9,000 during 1959. Over 1,100 entrants sat for the 1959 Amateur Licence Examination, 657 passed, 59 per cent of the applicants.

Christmas DX

Around Christmas time the 7 Mcs band provided some good CW DX in the mornings from 5.30 to 7.00 a.m. Even the east coast K/W's were work-able the long way round, good DX on any band. 7 Mcs is well worth looking at in the mornings if you are an early riser.

Quite an amount of opposition has arisen against the ARRL's proposal to the F.C.C., reported previously, for an extension of the U.S. 14 Mcs telephony allocation to 14,350 Kcs.

Comment against the change has come from Canada. The RSGB has written to the ARRL expressing the hope that the proposal would not be proceeded with. If such a change took place it would certainly upset the accept-ed operating balance on the band.

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R. and H. Low Input Stereo Preamp. Box heavily dichromated. 59/6, plus 25 p.c. S.T. Engraved front plate in burnished aluminium with dark red figures, 40/, plus 25 p.c. tax.

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Cases and chassis made to your own specifications.

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R. and H. Simple Pattern Generator. Case chassis and printed front panel, £3/4/6 plus 12½ p.c. tax.

Any of the above with Engraved front panel, £1/15/ extra.

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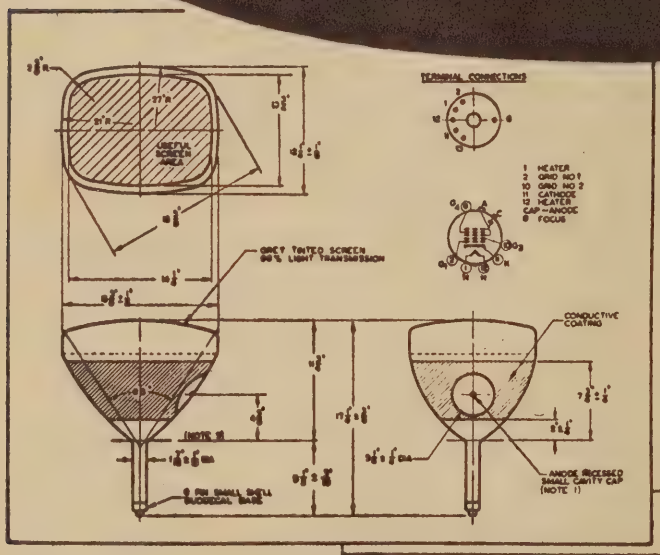

THOMAS ELECTRONICS

Australia's only independent television tube manufacturer, has introduced the 17CGP4—a 17-inch, 70-degree electrostatic focus CRT which can be *safely* used without an ion trap. The 17CGP4 is a direct replacement for the Thomas 17HP4, but is not intended to replace the magnetic 17-inch, 70-degree 17BP4/300.

NOTES

- *A short, straight electron gun not requiring an ion trap.*
- *A grey-tinted face affording approximately 66 per cent. light transmission.*
- *Spherical face.*
- *Electrostatic focus.*
- *External conductive coating.*
- *Metal-backed screen.*
- *Anode and Grid No. 3, which are connected together within the tube, are referred to herein as anode.*
- *Cathode should be returned to one side or to the mid-top of the heater transformer winding.*

SPECIFICATIONS

Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflecting Angle (approx.):	
Diagonal	70 Degrees
Horizontal	65 Degrees
Vertical	50 Degrees
Phosphor	P4 Aluminised
Fluorescence	White
Persistence	Medium
Faceplate	Grey Filter Glass
Light Transmission (approx.)	66 Per Cent.
Heater Voltage	6.3 Volts
Heater Current	0.6 ± 10 Per Cent. Ampere
External Conductive Coating to Anode	
Capacitance:	
Maximum	1,500 pf.
Minimum	750 pf.
Ion Trap Magnet	None
Picture Area (approx.)	153 Sq. Ins.
Anode Voltage (Note 1)	16,000 Volts, D.C.
Grid No. 4 Voltage (focusing electrode):	—500 to +1,000 Volts, D.C.
Grid No. 2 Voltage	500 Volts, D.C.
Grid No. 1 Voltage:	
Negative Bias Value	140 Volts, D.C.
Positive Bias Value	0 Volts, D.C.
Positive Peak Value	2 Volts, D.C.
Peak Heater—Cathode Voltage (Note 2):	
Heater Negative with respect to Cathode:	
During Warm-up Period (not to exceed 15 secs.)	410 Volts, D.C.
After Equipment Warm-up Period:	180 Volts, D.C.
Heater Positive with respect to Cathode:	180 Volts, D.C.
Anode Voltage	14,000 Volts, D.C.
Grid No. 4 Voltage (Note 3):	—50 to +350 Volts, D.C.
Grid No. 2 Voltage	300 Volts, D.C.
Grid No. 1 Voltage (Note 4):	—28 to —72 Volts, D.C.

Thomas ELECTRONICS OF AUSTRALIA PTY. LIMITED

Sales enquiries and technical information from:
TELEVISION PICTURE TUBES (AUST.) PTY. LTD.
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ON SHORTWAVE BY ART CUSHEN

TUNISIA BEGINS SHORTWAVE BROADCASTING

A new country to the shortwave field, Tunisia, was heard in late December with its first broadcast on 6125 Kc.

SCHEDULED to take the air in September, the transmissions were first eard in late December, when the freuency of 6125 Kc. was used. Tunisia to use also transmissions in the 16 nd 19 metre band; but, from our obervations, at the moment only one freuency is in service.

The station has the Arabic proams, and is broadcasting from 3.30 after 6.00 p.m., 9.00 to 11.30 p.m., .00 to 8.10 a.m. News in Arabic is roadcast at 3.45 p.m., 4.30 p.m., 5.25 .m., 10.00 pm, 2.00 a.m., 4.00 a.m., .00 a.m., 6.00 a.m., 7.45 a.m.

The station identifies as "Huna Tunis," hich has been heard at 6.00 p.m. Up this time the frequency is covered by ie B.B.C. in its General Overseas Serice.

In the mornings, the Tunis frequency clear to 6.00 a.m., after which some nterference has been noted from Mosow. The station has the address of 39 Ave. de Paris, Tunis, Tunisia.

English from Bucharest

THE Rumanian station Radio Bucharest carries its English broadcasts to Europe from 5.30 to 6.00 a.m., on 9520 nd 6210 Kc., 7.00 to 7.30 a.m. on 7195, 990 Kc., 8.30 to 9.00 a.m. on 7195 and 990 Kc. To North America from 11.00 11.30 a.m. on 11810, 9520, 7225, 195, 6210, 5980 Kc., noon to 1.00 p.m. ame frequencies, and 2.30 to 3.00 p.m. n 11810, 9520, 9570, 7225, 7195, 6210 nd 5980 Kc.

To the Near and Middle East the roadcasts are from 3.30 to 4.00 a.m. n 7195, 5.00 to 5.30 a.m. on 9520, 210 Kc. In addition to the news broadasts, Radio Bucharest has a programme f music every day from 2.00 to 2.30 .m., using 11900, 9520, 7195, 6210 and 980 Kc.

Los Angeles

NEW frequencies have been put into service for the winter schedule by ie Armed Forces Radio and Television ervice, at Los Angeles.

At present the AFRTVS schedule is rom 8.00 a.m. to 1.00 a.m. the following ay, and is carried on the KCBR transitters, as follow: KCBR1 200 Kw., rom noon to 3.00 p.m. on 21740 Kc. CBR2 50 Kw., 9.00 a.m. to 2.30 p.m. n 21460 Kc., 3.00 p.m. to 1.00 a.m. n 9700 Kc. KCBR3 50 Kw., 9.00 a.m. 2.30 p.m. on 17815 Kc., 3.00 p.m. to 0.00 p.m. on 5965 Kc. KCBR4 100 .w., 2.00 p.m. to 5.15 p.m. on 11875 c. KCBR5 100 Kw., 2.30 to 9.30 p.m. n 6060 Kc., and 10.00 p.m. to 1.00 a.m. n 15315 Kc.

Programmes include news almost every our on the hour, while the programme onference Period at 9.05 a.m. and 5.05 m. gives news on frequency and proramme changes. Verification is by card om the AFRVTS headquarters.

International Broadcasts

TWO of Europe's leading commercial stations, Andoradio and Radio Monte Carlo, have both commenced programmes each week for the wider international audience. Andoradio, which we verified several months ago on 6305 Kc., has begun a session of International Requests on Saturdays from 7.30 to 9.00 a.m., and the announcements are in Spanish, French, English, German and Italian. Radio Monte Carlo has its session on Mondays from 8.05 to 9.00 a.m., and is tuned on its normal frequencies of 6035 and 7140 Kc.

This program has announcements in English, German, Spanish, Italian, Russian, Arabic, Greek, Turkish and Yiddish. Both these stations are commercial ones, and their normal daily output is beamed to listeners in Spain and France, two countries which do not have commercial broadcasts.

B.B.C. Uses 75 metres

THE European Service of the B.B.C. from London is now being carried on two frequencies in the 75-metre band, and reception of these transmissions, which are all in English, should be possible in this area. The B.B.C. is using the frequencies of 3952 Kc. MCM and 3975 Kc., with the call GRC.

The program on 3952 Kc. is from 7.15 to 7.30 a.m., with English by Radio, and from 7.45 to 8.00 a.m. with news and news commentary. The frequency of 3975 Kc. is on the air from 3.00 to 3.15 p.m. with English by Radio, 4.00 to 4.30 p.m. Morning Half Hour with news and talks, 4.45 to 5.00 p.m. English by Radio, 5.00 to 5.30 p.m. Morning Half Hour, and from 5.30 to 5.45 a.m. the news at dictation speed.

Another new B.B.C. frequency we have observed is 18080 Kc., a channel which has not been in use for many years. This one has the GOS relay from 1.00 to 4.15 a.m., with news at 4.00 a.m.

ZYE21 on 15245 Kc.

STRONG signals from a new Brazilian, which have been heard to sign off at 11.50 a.m., have been identified as ZYE21, in Balem, Brazil. The station, using 15245 Kc., carries a news bulletin in Portuguese at 11.30 a.m., and after a few commercial announcements, leaves the air at 11.50 a.m. The address for reports is Box 491, Balem, Brazil, and the station uses the slogan "Radio Marajoaba" during its broadcasts.

Reports from Europe and North America also tell of good reception, and the station in Europe has been tuned from 5.00 to 9.00 a.m., and on some days the transmission appears to have a break from 7.00 to 7.30 a.m. North American listeners, like ourselves, are hearing the transmission to sign off at 11.50 a.m. with a march.

Another nearby signal in Brazil, that of ZYR206 on 15415 Kc., which is being heard to 1.00 p.m., has verified our reception after some 10 months, and this came in a letter from the director of the station.

The station is Radio Clube De Ribeirao Preto, P.O. Box 18, Ribeirao, Preto, Estado de Sao Paulo, Brazil. The station uses 1000 watts on 15415 Kc. Verification from Maria Augusta Barbosa was in English, and in part stated "that all indications given on your report were correct. Best regards and greetings fom Brazil to you and people of your country."

FLASHES FROM EVERYWHERE

TURKISH station Radio Istanbul has been heard in Europe with weak signals on 6622 Kc. The station, which is one of the many low-powered stations in this country, operated by Schools and Colleges, operates on weekdays only, and is on the air from 1.00 a.m. to 7.15 a.m.

BRAZZAVILLE has been heard in New Zealand at good strength on its new 9730 Kc frequency, when in a service to the European and African area. The station opens at 3.00 p.m. and at 3.15 p.m. it presents a news bulletin in English. The transmission actually continued to 6.00 p.m., but we have found at 3.30 p.m. the jamming interference is so severe that little of the remaining broadcasts are heard. The station at the same time is using 11730, 15445 and 21500 Kc for this service, which is on the air each day from 3.00 to 6.00 p.m. Radio Brazzaville has been noted in Europe from 2.30 and 6.30 a.m. on 9545 Kc, while Radio Chad has a news bulletin at 4.15 a.m. in French, according to the Swiss DX Session, which reports them on 4905 Kc.

INDONESIAN transmissions to Australia and New Zealand, which take the air in the one-hour transmission at 9.00 p.m., have now been observed on three frequencies by Bill Hawthorne, of Warrnambool, Vic. The station has in the past used 11795 and 9710 Kc but a new outlet of 7295 Kc. also carries the transmission. The station, when opening, makes no reference to the 41 metre band outlet.

ETHIOPIAN station Radio Addis Ababa has been giving good reception in Europe on 15345 Kc for the period 6.00 to 7.00 a.m. During this time the normal interference is not experienced, and the programs are of western recordings with announcements in English. The programs are best received on Sunday and Monday mornings, when the Buenos Aires station, which uses the same frequency, does not appear to be on the air.

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3. Tape—1200ft. of Pyrox only £2/10/-.

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HELSINKI, in Finland, has been heard in two English transmissions on Saturday, the first from 2.00 to 2.30 a.m. on 6120, 15190, and 17800 Kc. The broadcast at 9.30 p.m. to 10.00 p.m. is on 15190 and 17800 Kc.

LIBERIA is to have a new commercial station, which will be broadcasting from the capital Monrovia. A British company is planning to install a station, which will serve the area and capable of operating on eight frequencies, and the station will be financed from the sale of commercial programs. This station is expected to be on the air this month and its reception will be looked forward to in the coming equinoxial period.

BRAZILIAN station Radio Gazetta, Ave. Casper Linero 88 Sao Paulo, is operating from 8.30 p.m. to 7.00 a.m. on ZYR238 on 15325 Kc. Broadcasts 1.00 a.m. to 1.00 p.m. on ZYR227 9685 Kc, and from 9.00 p.m. to 3.00 a.m., 7.00 a.m. to 2.00 p.m. on ZYR227 on 5955 Kc. Radio Rural in Rio de Janeiro now broadcasts from 8.00 to 10.00 p.m. and 6.00 to 8.00 a.m. on 6065 and 15105 Kc both with 7500 watts. The station has news in Portuguese at 8.30 p.m. and 6.30 a.m.

Notes of reception from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

SAUDI ARABIAN Broadcasting System has reduced its number of transmitters, according to a letter from the station. Broadcasts are now on the air from Mecca, 1.30 to 2.45 p.m., 9.00 p.m. to 11.20 p.m. on 11850 Kc, and from 3.00 a.m. to 5.10 a.m. on 6100 Kc.

TIRANA, in Albania, operates its foreign service 2.00 to 3.00 p.m. on 7157 Kc in Arabic, and from 4.00 to 5.00 a.m. the program on 7850 Kc is in Albanian, and from 5.00 to 8.00 a.m. on 7157 and 7850 Kc. This latter transmission has Arabic at 5.00 a.m., then 6.00 a.m. in Greek, 6.30 a.m. in Italian, 7.00 a.m. in French, 7.30 a.m. in English, while the last transmission from 7.00 to 8.00 a.m. is on 7157 Kc with Serbo, Croat and Greek.

BERLIN International, a station of the East German Government, has put a new high-powered transmitter on 11765 Kc. This station, which carries the normal Radio D.D.R. Programmes, is on the air as follows: To the Near East, German 4.00 to 5.00 p.m. and 11.00 p.m. to 2.00 a.m. and 6.00 to 9.00 a.m. on 11765 Kc. Arabic is broadcast from 2.00 to 4.00 p.m., 9.00 to 11.00 p.m., and 3.00 to 6.00 a.m. on 9730 and 11765 Kc. English from 2.30 to 3.00 a.m. on 11765 Kc. Programs to North and West Europe as before, when transmission is on 6115 and 7300 Kc, and English news is released at 4.00, 6.00 and 8.00 a.m.

SENEGAL Radio Mali, Dakar, will shortly be operating a 100 Kw. short-wave transmitter. This is to be used for broadcasts overseas and should provide yet another reliable signal from North Africa.

SYRIA stations of the United Arabic Broadcasting Service, with studios in Damascus, are now broadcasting the Home Service on 6165 Kc. and 11250 Kc. with 20 Kw. and 500 watts of power, are on the air from 2.00 to 6.00 a.m. in Arabic, 9.00 to 9.30 p.m. in Turkish, 9.30 to midnight in Arabic, midnight to 1.00 a.m. in Hebrew, 1.00 a.m. to 9.00 a.m. in Arabic. The service to Europe from 5.00 to 600 a..m. is on 15165 Kc. in English and French, and 6.00 to 7.00 a.m. in Arabic to North Africa. A service to Central America in Spanish and Arabic is released from 10.00 a.m. to noon on 15165 and 17865 Kc.

RHODESIAN signals are being heard by Bill Hawthorne, Warrnambool, Vic., on 6020 Kc. from 6.00 a.m. The station is using English and frequent commercial announcements, and was firstly presumed to be the Springbok Radio in Johannesburg. Commercial radio is relatively new to the programming of the Federal Broadcasting Corporation in Rhodesia.

BRAZZAVILLE, using 9545 Kc., has been giving good reception at 5.45 a.m., when they carry a program of English news. This is one of the newest frequencies, which is used from Brazzaville in its service in the broadcasts of "The Voice of France in Africa."

SARAWAK has interchanged its broadcasts on its 4950 and 5037 Kc. The 4950 Kc. station is now heard in Malay and English, while the other frequency has the Chinese and Iban services. The midday transmission, from 2.00 to 3.30 p.m., is using 9565 Kc. at the moment. The English service from Sarawak is heard on 4950 Kc., and the station signs off at 12.30 a.m.

HANOI is using the new frequency of 7010 Kc. from 8.00 p.m. and at 1.00 a.m. It is heard in parallel with 9765 and 15020 Kc. These broadcasts from the Voice of Vietnam, in the Northern Vietnam Republic, has a session of news in English at 1.15 a.m.

NEW YORK station WRUL has been heard in a session of answers to letters from listeners, called "Listeners' Corner," and heard on Sunday from 8.00 to 8.15 a.m., at which time the station leaves the air. The signals are heard on 15380 and 17750 Kc., and the station offers a program guide to those who write WRUL, 57th Street, New York City, with this request.

CAIRO is providing good signals in Tasmania, reports Graeme Wilson, of Mt. Seymour, who is hearing this Far East transmission on 17910 Kc. The broadcast is tuned with English at 11.45 p.m. to 11.55 p.m., and then plays Indian folk music. The station announces as "This is Cairo Calling in the United Arab Broadcasting Service." The signals are very strong during this transmission.

BRAZILIAN station Radio Timbira is reported by World Radio Handbook to be operating on 15215 and 4975 Kc., with broadcasts from 9.00 p.m. to noon.

GOA, which for some months has been reported to be installing new equipment, is still using its low power, and is now broadcasting at 11.30 a.m. to 7.30 p.m. and 9.00 p.m. to 3.30 a.m., on 4850 and 9610 Kc. English is carried from 4.30 to 5.30 p.m., 5.30 to 6.30 p.m., and 2.30 to 3.30 p.m. Other programs are in Portuguese, Hindi, Urdu, Marathi and Gujerati.

ISRAEL is understood to be the location of a weak signal heard in Arabic on 7189 Kc. The station has programs mainly of news, and has been heard in Switzerland from 3.00 to 6.15 a.m.

CONGO BELGE RADIO, in Leopoldville, broadcasting on 9385 Kc., is continuing to be heard well, and in both its afternoon and morning transmissions can be heard with French broadcasts. The station operates from 3.00 to 4.30 p.m., with news at 4.00 p.m., and also from 3.30 to 8.00 a.m., with news at 4.30 a.m.

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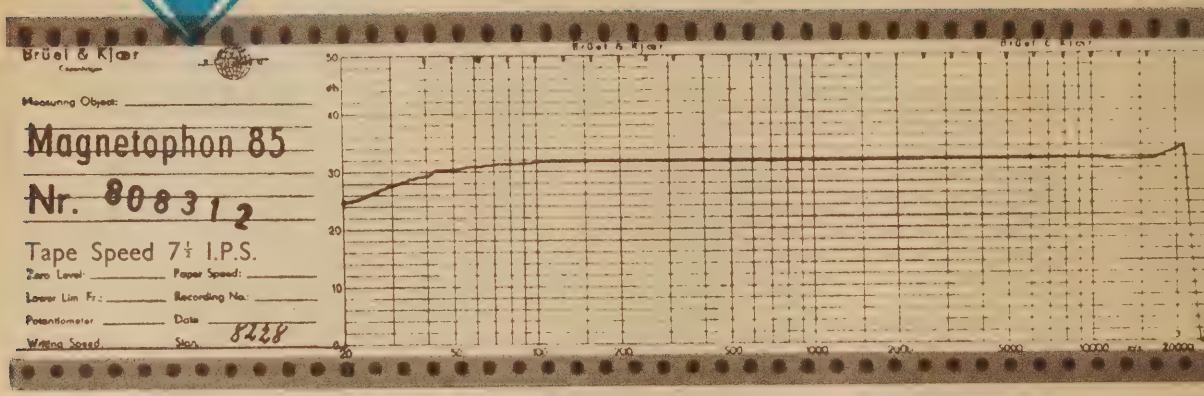

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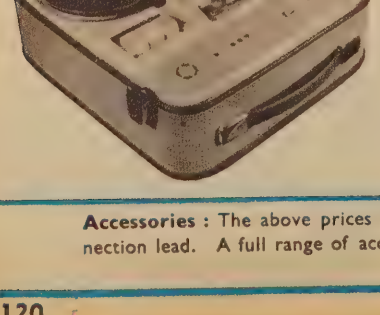
MAGNETOPHON 85K Portable... £195/15
Tape speeds 7½ and 3¾ i.p.s. Frequency Range 30-20,000 c.p.s. at 7½ i.p.s. 30—15,000 c.p.s. at 3¾ i.p. Spool size 7 in. Playing time for 2400 ft. Doub Play Tape 2 x 2 hours 6 minutes at 3¾ i.p.s. Sign to noise ratio ≧ 50 dB. Automatic stop at end tape. Two 7 in. x 4 in. loudspeakers with 3 wa output.

MAGNETOPHON 85K Stereo ... £210/0
Technical specification as for Model 85K wi additional facilities for playing stereo tapes.



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Victoria : Maxwell's Radio Pty. Ltd., 369 Lonsd St. Melbourne. Melbourne Tape Recorders, Elizabeth St., Melbourne.

Queensland : Messrs. Chandlers Pty. Limit Brisbane and Branches

South Australia : Messrs. Newton McLaren Lt 17-23 Leigh Street, Adelaide.

Accessories : The above prices include a dynamic microphone, one spool of tape, empty spool and radio connection lead. A full range of accessories also available.

ANSWERS TO CORRESPONDENTS

R.B.P. (Burra) wishes to build the ıple Stereo Amplifier of July, 1958, wishes to separate the first stage from remainder of the amplifier.

A.: Main objection to this is that the el at the output of the 12AU7 is low ugh to require shielding, and may lead losses if long lengths of connecting le are used. The extra grid return stor should be about 2M, although probably could be used if necessary minimise any hum trouble. It may necessary to provide an additional ring network from the second elec- ytic (50 mfd) if a tuner is to be d, due to the higher current drain.

D.O.E. (Clayton, Vic.) submits a num- of queries, some dealing with basic ory and one concerning guitar ampli-

A.: We cannot deal with your theory stions in detail, D.O.E., and these be found in any elementary text k. Briefly, Miller effect is the effect reby the grid plate capacitance of the e appears as a very much larger acitance across the input (grid-cath- circuit. It is worst in triodes which a high grid-plate capacitance, mak- them unsuitable for use in many o applications. It is not dependent he signal level, but is related to the edance of the circuit being most blesome in high-impedance circuits. he various class of valve operation to the proportion of the signal lled by the straight portion of the ating characteristic. In class A the le of the signal is handled by the ght portion, while in class B approxi- ly half only is accommodated. In r to avoid distortion, two valves must sed, one to handle each half of the l. Class AB is intermediate between two.

ass C handles only a very small por- of the signal, and is used only in unction with a tuned circuit which tains the signal during the remain- of the cycle. It is normally used in amplifiers in transmitters, etc. We est the R.C.A. Receiving Tube ual as an inexpensive book cover- he above in greater detail. We have no work on the guitar circuit of type you describe and regret we ot help you.

any thanks for your kind comments t the magazine.

W.W. (Sandringham, Vic.) has a lard Champion receiver as described e July 13, 1934, "Wireless Weekly," wants to know if anything can be to improve the low-frequency sen- y, which is noticeably poorer than igh-frequency performance.

There appear to be two possible s of this. One is the use of the old low-impedance primary aerial and coils and the other concerns the ing. The substitution of modern impedance aerial and R.F. coils d help considerably, since the older were poor in this respect. In the r of the tracking it is not possible lp very much, since there appears some confusion over the various sections. We assume the two critical trimmers would be the R.F. and oscillator sections, and the broad one the aerial section. The fault may be partly in the aerial coil, since none of the adjustments should be as uncritical as you suggest. Varying the inductance of each coil by means of an iron dust core (to increase) or a brass rod (to decrease) may help to sort things out. We also suspect that the padder is not being adjusted correctly, the implication being that this is being treated in the same manner as a trimmer. We suggest reference to the March, 1958, issue for alignment instructions, and copies of this issue are available if your files are incomplete. Finally, while apreciating the affection one must have for a set of this age, we must point out that the combination of the 175 Kc I.F. and the R.F. stage must result in such a degree of selectivity as to cause very serious side band cutting. Modern tuners would be capable of very much better performance than this. On the other hand, the audio section would still have merit, though it, too, lacks modern refinements.

J.A. (Pymble, N.S.W.) enquires whether the voltage from the secondary of a 150V 30 mA transformer is dangerous, as he has experienced a mild shock from it.

A.: While such a winding might be regarded as less dangerous than the mains, we prefer to treat all H.T. windings with considerable respect. Never deliberately expose yourself to the risk of a shock from such a source, even though this will seldom result in more than an unpleasant "bite." Given sufficiently favourable conditions, such a winding must be regarded as dangerous. Remember that a voltage as low as 25 is about all the average person can stand without undue discomfort when efficient connection is made to the conductor.

You may be able to improve the selectivity of the "All Band Three" by reducing the size of the aerial. This should be no longer than necessary to give adequate volume on the local stations. We have a number of amplifier circuits on our files, but it would be easier to select one for you if we had some idea of the purpose for which it was intended.

D.R. (Ballarat, Vic.) wants to know if we have any plans for a new guitar amplifier, and suggests that any such design should include a vibrato attachment.

A.: Many thanks for your letter and suggestion, D.R., and we will keep this idea in mind. We have no immediate plans for a new circuit.

R.D. (Kedron, Q.) wants us to describe a pocket type transistor radio, preferably to operate from solar cells.

A.: We would be happy to oblige, R.D., but for the fact that the supply of subminiature parts is very uncertain as yet. In regard to the solar cells, we know of no quantity supplies in this country such as would be necessary to justify a project. In addition, some form of storage battery may be required for use in conjunction with these in order to provide continuous operation.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

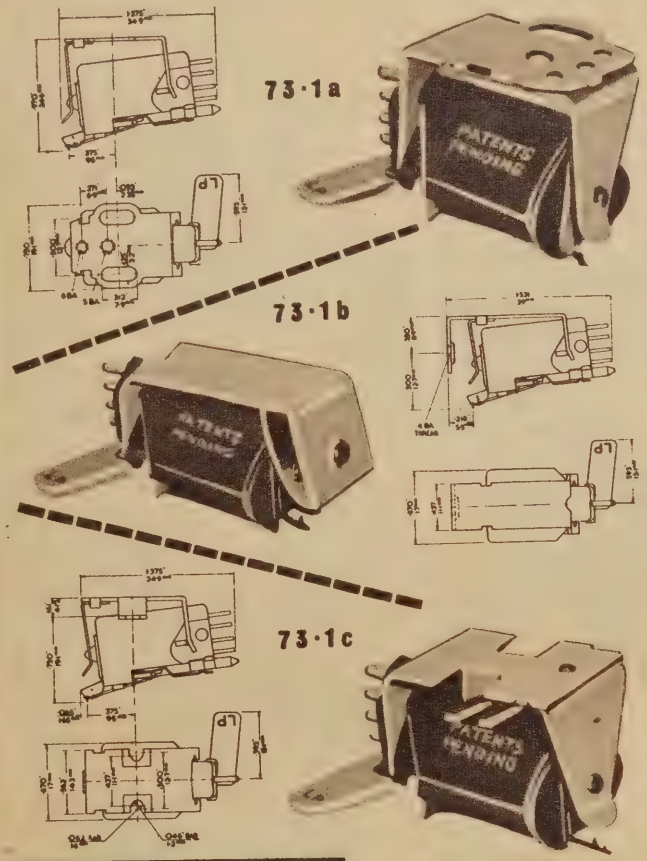
(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

acos

Crystal stereophonic cartridge

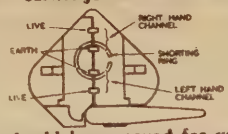


The "ACOStereo" 73-1 is a universal cartridge designed to play stereophonic and monophonic discs, including 78 r.p.m. coarse groove records. Three brackets are available. The "a" bracket fits the majority of arms, the "b" bracket fits Garrard RC. 110 and RC. 120 changers, and the "c" bracket is intended for American arms of the VM type.

The output from the "ACOStereo" 73 is flat when fed into a 2Megohm impedance. If record compensation is available in the amplifier, it is advised that the output is converted to constant velocity characteristics by feeding through this circuit:—

The left-hand channel is defined as the channel reproduced by the left-hand speaker when viewed by the audience, and is recorded on the left-hand groove wall when the record is viewed as:—

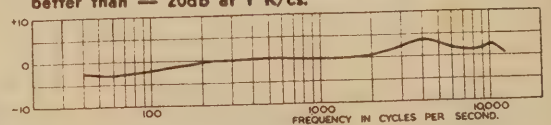
The "ACOStereo" cartridge connections as seen from the rear:—



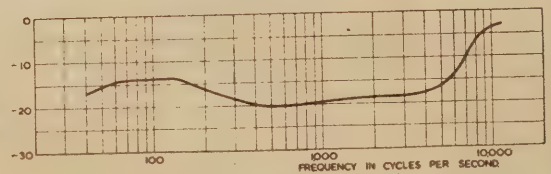
The shorting ring should be removed for use with amplifiers requiring separate leads.

PERFORMANCE OUTPUT — 160 m.v. at 1 cm/sec.
Average — 300 mv.

FREQUENCY RESPONSE—
40—12,000 c/s.
SEPARATION between channels at
1 K/cs better than 20dB.
Radii of Stylus tips—0.0005" (13.5 microns).
0.0025" (62 microns).
Recommended load: 2 Megohm.
(Compliance equals 3.5 ucm/dyne).
(Stiffness equals 0.0286 x 10 dynes/MM).
Recommended downward pressure: 3-4 Grammes.
The Stereo recording characteristics is within ½dB of the RIAA/BS 1928/1955 characteristics, and cross talk is better than — 20db at 1 K/cs.



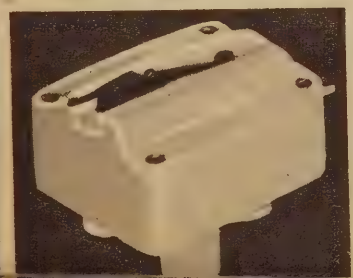
Frequency response on PS.131.



Separation between Channels on PS.131.

The response of both channels will be within 3dB.

All 73 series cartridges are available with two sapphire, sapphire and diamond or two diamond styli.
Prices: 73 series — Cartridge incl. 2 sapphire styli, £5/15/-, with sapphire and diamond styli £11/18/6, with 2 diamond styli £15/19/6.
Available ex stock.
'How Stereo Works" gladly posted on request.



71-3 For stereophonic and L. P. discs (non-turnover type).

With Sapphire stylus—Price £4/9/6

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AMPLION (A/SIA) PTY. LTD.

101 Pyrmont Bridge Road, Camperdown,

SYDNEY, N.S.W.

ELECTRONIC TACHOMETER

(Continued from Page 71)

gainst the body without any separate over.

For watercraft some additional pre-aution will be necessary, due to the cor-osive effects of salt water. One sugges-ion is to make a close fitting lid from lastic or metal and to seal this in place ith caulking compound. By similarly eating the cable holes it should be pos-ible to make a virtually watertight unit.

The meter, being separate, can be eated on its merits, but may be best moved from salt water environments if ot required for long periods. Much ill depend on individual units and hether they are intended for this class f work.

ONNECTING LEADS

Two leads emerge from the case, one nnecting to the meter and the other to e electrical system. The meter cable ay be ordinary twin plastic ("figure ght") and the opposite ends should be arked in some obvious way to ensure rrect polarity when connecting to the eter.

The other cable is a length of PVC acuum Cleaner Flex (23/.0076), with o of the conductors serving as battery nnections and the third for signal pick- from the distributor terminal. They e best terminated in suitable auto-otive type terminal lugs. It appears gical to use the red and black wires for sitive and negative battery leads re-ectively, leaving the green wire as the nal lead.

The type of meter to be used will de-nd largely on personal taste and the ount of money which may be justified. working to a budget, it should be pos-le to find a suitable disposals type, ce it is not even necessary to have a ictly accurate movement. It is more portant to have good bearings and edom from any suggestion of sticking. Assuming 5,000 r.p.m. as a top figure, cale calibrated "0 to 5" or some mul-e of this will be most convenient. st such scales will have 50 divisions, king each division equal to 100 r.p.m. he very highest accuracy is required scale may be hand calibrated, but the put is sufficiently linear to allow a mal linear scale to be used with suffi-nt accuracy for most purposes.

f cost is no object a 250 degree meter uld be ideal in many applications. As l as presenting a large, easy-to-read e, such a style is more likely to match r panel instruments, such as the dometer. With a little care, such a er could be made to look part of the rument panel, rather than something iously foreign to it.

leters of this type are available in ral sizes from at least two local r manufacturers, being intended narily for switchboard use. Unfor-tely, they are not cheap, costing be-n about £15 and £20, according ize, style and make. However, there be many applications where such can be justified.

aving completed the unit, we come he question of calibration. This may one by comparison with an existing ument or even, in a rough kind of by comparison with the speedo-meter if the relative engine speed is known or can be calculated.

However, speedometers are notoriously inaccurate devices. Early American models were allegedly designed to read high to give the customer the impression that his car was capable of better performance than it really was. British and Continental designs are more conservative, but are unlikely to be accurate at more than one or two spots on the dial. 30 m.p.h. appears to be one spot at which many of them are calibrated.

A far better approach is to use an audio generator and a CRO, and any reasonably good type of either instrument is all that is required. The generator may deliver either sine or square waves, should be able to deliver at least six volts into the unit, and cover from 25 or 50 cps to around 400 cps.

Unless the calibration of the generator is known to be very accurate it is far better to use the mains as a frequency standard. This can be done quite easily by substituting a 50 cps supply (as from a filament transformer) for the regular CRO time base and applying the pulses to the vertical plates.

The pulses may be picked up from the meter circuit(the meter bypass must be disconnected) or from the base of the 2N185 if this is more convenient. Either set of pulses give a pattern which is easier to interpret than the conventional Lissajous figure, even though it is only a variation of the latter, due to a change in wave form.

SPIKES

The result is a series of spikes extending up or down from the base line, and it is only necessary to count these to establish the relationship to 50 cps. Thus there will be one spike for a generator frequency of 50 cps, two for 100 cps, and so on.

However, one spike also may be observed at 25 cps, while three may be observed at both 75 and 150 cps. There will be an obvious flicker of the pattern under these conditions, but is a handy way to make checks at 25 cycle intervals if this should be required.

Relating cycles per second to engine revolutions per minute is not difficult. Putting aside two-stroke engines, or magneto systems which may fire twice in the firing cycle instead of once, we may calculate the number of pulses by multiplying the engine speed by the number of cylinders and dividing by 120.

Conversely, the r.p.m. indicated by a known number of pulses may be found by multiplying the pulse frequency by 120 and dividing by the number of cylinders. This is most useful where we are limited to spot frequencies checked against the mains as described above.

Thus, at 5,000 r.p.m., a four-cylinder engine will deliver 166 pulses, a six-cylinder type 250 pulses, and eight cylinders 333 pulses. Using a check point provided by the mains at 250 cps, the unit may be calibrated at full scale for a six-cylinder engine, the tapping on the 100 ohm pot being adjusted until this frequency into the unit gives full scale deflection.

For four and eight- cylinder engines the nearest convenient check points will be 150 cps (4,500 r.p.m.) and 325 cps (4,900 r.p.m.) respectively. Having set the unit to give these readings, other points on the scale may be checked for linearity.

Connecting the unit into the electrical system is simple enough. The signal (green) lead connects to the low tension terminal on the distributor or the corresponding terminal on the coil if this is physically more convenient.

The other coil terminal may be used as a power pick up point, and this ensures that the unit will not draw current unless the ignition system is switched on. The red or black lead should be used for this, according to whether the system uses a positive or negative active lead respectively. The remaining lead then connects to any convenient chassis point.

HEAT

The location of the unit or the meter is not critical in the electrical sense, almost any length of lead being permissible in either direction. However, for fairly obvious reasons, it would be unwise to mount the unit in the engine compartment, where the temperature will be greatest. If it can be located on the passenger side of the bulkhead, or well away from the engine in a boat, even the small changes due to heat will be minimised.

A road test should indicate at least approximate agreement between the tachometer and the speedometer, but with the reservations already discussed concerning the latter. If there is a gross discrepancy, the instrument is best tried on another vehicle, particularly if the history of the first one is in any doubt.

It is quite possible, for example, for the diff. ratio on a second-hand vehicle to be quite different from what is stated in the relevant handbook. It is not unusual for manufacturers to modify this as new models are produced, or to make the same chassis suitable for commercial as well as private use.

A typical example is the Austin A40. Early models (a rather vague term in itself) are listed as using 5.43 to 1, later models 5.14 to 1, and the commercial version 6.143 to 1. Fairly obviously, any type of these versions could have been used by someone interested in making a quick and cheap repair. The tachometer may well "detect" such differences.

In short, assuming the instrument behaved logically during calibration, it is most likely that any discrepancy is due either to speedometer inaccuracies, "foreign" transmission systems, or combinations of both.

EXPERIMENTS

Many readers will naturally be wondering about the prospects for 6-volt operation. As we said earlier, there are a number of problems involved and, as far as we know, there are no commercial units of this type available at present.

However, we have conducted some preliminary experiments and have actually produced a unit which will operate from 4 volts after allowing for losses in the regulation system. Assuming a satisfactory solution to some of the regulation and other problems, we hope to present something on this subject in the near future. Similarly, we may consider some of the problems associated with a test instrument type of unit.

Yes sir! THERE'S A RANGE OF

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TO SUIT YOUR EVERY REQUIREMENT

TYPE W 99 MICROCAP

★ Patented construction of patterned metallized paper allows extremely small size for miniature applications.
★ Leads actually soldered to unit ensuring positive contact of great strength.
★ Suitable for wide range of frequencies up to and exceeding 100 mega-cycles per second.
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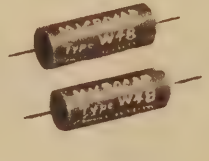

TYPE W 48 MICROCAP

★ Metallized paper construction with compact size for applications where space is limited.
★ Wide range of values up to 2 mfd.
★ Extremely low inductance not exceeding that of a piece of metal of similar size.
★ Well-known self-healing feature.

TYPE L 51 PAPER & FOIL CAPACITORS

★ Overlapped foil construction resulting in self inductance of extremely low value.
★ Connections bonded to foil by special process ensuring low resistance at high frequencies.
★ Tough moulded casing providing clean engineering finish and wide range of operating temperatures
★ Available in a wide range of preferred values up to 1,500 volts D.C. working.

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AE21

COMMERCE — AND A PACK OF CARDS

Continued from page 19

If you have grasped all this, it will be easy for you ɔ interpret the punching in the other columns. For in-tance, the Job Number is 022162. The Clock Number is 208. Works Order Number 014370 and so on.

It will be noticed that the 10 and 11 is only marked n the card in the money columns, in this instance at the ɔp of columns 70, 76 and 80. These positions are avail-ble, however, in all other columns for special purposes.

By providing the 10 and 11 in the positions shown, the ım of tenpence and elevenpence can be punched on the ard without the need for an extra column in the pence eld.

Once you have grasped the general idea of the meaning f the punch holes in the card, it is a simple matter to anslate them into the necessary figures.

In addition to the numerical functions of a punched ard it also has an alphabetical function. By punching two oles in one column the card becomes coded for a letter f the alphabet.

This is done by using the ten and eleven position on ıe card in conjunction with a number in the same column, ith the exception of G, I, O, and S.

The alphabet is thus coded and is illustrated in the companying diagram.

IVIDED INTO ZONES

The card is divided into zones of position 10 (called ıe X zone) in combination with positions 0 to 9. The next ɔne is that of position 11 (called the Y zone) in combina-ɔns with positions 0 to 9.

It will be clear from the diagram that A is coded by ınching a hole in the 10 position. B is 10 in combination ith 0 in the same column. C is 10 in combination with and so on. G is a punch hole at 6 only, while I is a ınch hole at 1 only.

From N to Z position 11 is punched in combination ith 0 to 9 with the exception of O and S which are and 8 only respectively.

When the card is thus punched in the proper alpha-tical and numerical positions, a special machine trans-tes the punching and actually prints the details on the p of the card. This is well illustrated in the picture of e Pay Advice Card herewith.

Although the numbered columns are not printed on is particular card the punching positions are there just e same. If you run your eye down the respective col-ıns from the figures and letters at the top and compare e positions with the diagram of the alphabetical code e whole matter should become quite clear.

Cards punched in this way are useful for filing away d sorting by hand from drawers, much in the same way an ordinary system card, but they can be analysed in ıchines by the punch holes.

When this translator machine was introduced the pos-ilities of punched cards was tremendously increased.

The punch hole is used for a variety of other purposes various machines which sense the hole and cause it carry out the following operations:—

File itself, eliminate itself, reproduce itself, sort itself, ıse a form to feed to a predetermined position or to ejected automatically, or to space from one position to ɔther, cause a total to be printed, post itself, produce automatic balance forward, select itself, print itself on card, divide itself by another number, subtract itself ım another number, add itself to another number and ltiply itself by another number.

NSING AT HIGH SPEED

All this is done electrically at tremendous speed by a ɔcess called sensing which will be explained in next nth's article.

The punched card therefore is a device which records ıic data from original sources. Once the cards have ɔn created and the accuracy of the punching checked as ɔlained later, no further reference to source documents necessary.

The card constitutes a permanent accurate and legible ord which is always available for processing by one of many machines devised for a specific purpose.

These machines are designed to accept stacks of cards ch are fed from automatic feed hoppers at great speed l accuracy.

Having described the card and its purposes we will ɔ see how the card is created.

Punching can be described as the conversion of data into holes which a machine is capable of sensing.

Let us assume that the wages or job card previously described is to be punched. Forms containing various data from the factory are collected and delivered to the punching desk.

Here a girl sits before a keyboard having fifteen keys, twelve of which correspond to the twelve positions in which holes can be punched in any column of the card.

The remaining three keys are for spacing, skipping and releasing the card in the case of a hand fed key punch. These hand fed punches are small and compact, require no electric current, being mechanical in operation. The card must be hand fed into the machine and removed manually.

REMOTE KEYBOARD CONTROL

There are Automatic machines which are electrically operated with keyboards similar to the hand fed machines. The keyboards are independent units which can be moved to the most convenient operating position or tilted to any angle. These keyboards are also interchangeable and can be replaced with an alphabetical keyboard when required.

Automatic punches made by Hollerith are provided with a storage device. This accumulates data from a series of key depressions and holds it temporarily until the operator presses a release key. By this means conscious errors can be corrected before actual punching thus avoiding wastage of cards.

Automatic punches have electrically controlled card feed and ejection facilities and are also capable of carrying out a variety of incidental operations such as spacing, skipping and so on. These operations are programmed for any required punching commitment by means of a plug-in control panel.

By thus pressing the keys the operator punches holes into the card corresponding to the data supplied on the factory documents.

Trained operators achieve very high speeds in punching. Speeds of up to 12,000 key depressions an hour have been achieved. This varies, of course, according to the difficulty of the punching.

NEXT MONTH:—

Calvin Walters continues this informative article and explains how the cards, duly punched with the relevant information, can be sorted, classified and analysed by automatic machines.

Because of the fundamental importance of correct punching, it is obvious that no card must be put into circulation unless the punching has been checked or, to use the correct terminology, "verified."

Verification is usually twofold. Firstly a check of each individual card and a rapid machine-assisted check of batches of cards by comparison of control totals.

The individual checking of the punched card is done on an Automatic Verifier.

The Verifier resembles the original punch with an ingenious difference. In the original punch a depression of a key operates a knife which cuts the hole in the card. The Verifier on the other hand is provided with plungers instead of knives.

In practice the punched card, together with the original documents are handed from the punch operator to the verifier operator. The latter then depresses the keys just as the punch operator did, as though she were attempting to punch the card again, from the original documents.

Depression of the keys causes plungers to fall. If the card is correctly punched for that hole, the plunger falls into the hole.

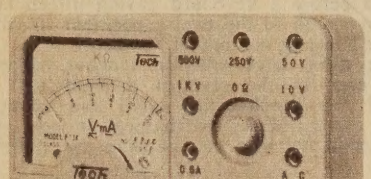
If, however the card is incorrectly punched and there is no hole where there should be one, the plunger will be stopped by the card and a red light shows to indicate an error. Errors due to incorrect punching, the presence of double punching in a single numerical column, or the omission of punching where required, are automatically and positively indicated.

Proof that cards have passed through the verifier is provided by the cutting of a small "V" shaped notch in each card completely verified.

(Continued on page 127)

MASTER ELECTRICS PTY. LTD.

A WHOLLY OWNED SUBSIDIARY OF MOTOR SPARES LTD.

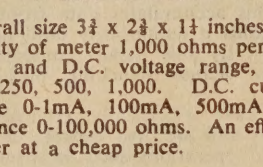


TECH. MULTIMETER

MODEL P.T.34

Overall size 3¾ x 2¾ x 1¼ inches, sensitivity of meter 1,000 ohms per volt. A.C. and D.C. voltage range, 0-10, 50, 250, 500, 1,000. D.C. current range 0-1mA, 100mA, 500mA. Resistance 0-100,000 ohms. An efficient meter at a cheap price.

Price only 61/.

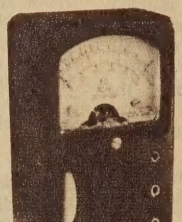


TESTER BOY MULTIMETER

The Tester Boy Multimeter is ideal as a portable instrument for the hobbyist, motor mechanics, etc.

Dimensions are: 6in high; 2¼in wide, 3¼ in deep. Weight 1lb 13oz. Ranges as follows: Volts, A.C. and D.C.: 2.5, 10, 50, 250, 500, 5,000. Resistance, 0-10,000 ohms, 0-100,000 ohms and 0-1 meg. ohm, DC current 0-1, 10, 500, mA. Decibels minus 20db, to plus 10db, to plus 22db. By referring to a chart, up to plus 56db may be measured. The case is black bakelite with a metal panel 3in meter. Test leads are provided and also a leather carrying case. Sensitivity of meter is 1,000 ohms per volt.

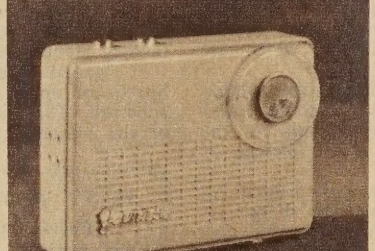
Price of this unit, £7/10/.



KEW MULTIMETER

Size 4in x 2in x 1½in. Complete with test prods. Ranges A.C. and D.C. Volts 0-15, 150, 1,000. D.C. current, 0-150 mA. Resistance 0-100,000 ohms. Sensitivity 1,000 ohms per volt. An ideal pocket meter for the serviceman, motor mechanic, home constructor.

Price only 69/6.



MIDGET CRYSTAL SET

CHIEFTAIN (as illustrated), with headphone, aerial and earth leads, etc., in Ivory bakelite case. 3 3-8in long x 2½in high x 1in deep. Provision for extra headphones. Using germanium detector, this set is reliable and efficient, with good sensitivity and selectivity. **Price, only £3/18/ each.**

SATO. Slug tuned miniature Crystal Set, in bakelite case, with indoor aerial and with leads and headphone at **Special Price, only £2/10/ each.**

HARMONY. GR57 Germanuim Radio, in midget Ivory bakelite case, 2½in long x 1in high x ¾in deep, set complete with earphone and aerial and earth leads. **Price, only 49/6.**

Q PLUS Crystal Sets. Cabinet is ivory Bakelite, size 5in x 3in x 3in, with fixed detector, works very well. Price, less headphones, £2/13/6. Price with headphones, 100ft aerial and 2 insulators, **£4/17/6.**

Q PLUS Transistorised Crystal Set, gives extra volume and extended range, complete with phones, aerial, etc. **Price, £6/19/6.**

100ft Outside Aerial Wire, for above Crystal Sets, **5/ each.** 50ft Aerial Wire, **3/6 each.**

SPECIAL NOTICE

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12. 10,000-Ohms **Carbon Pots, 2/ e**

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COMMERCE—AND A PACK OF CARDS

(Continued from Page 125)

We now have reached the stage where we have batches of correctly punched cards containing all the data which has been transferred from documents supplied from various sources.

The cards are now ready to be sensed and processed by the various machines. The underlying principles of sensing will be described in next month's article.

The punched card replaces the book entry in manual accounting and the item of numerical detail required in statistical analysis.

It constitutes a basic record from which all kinds of tabulations and statements are produced and printed automatically with totals and balances as required.

Once created and checked, the punched cards constitute a permanent and accurate record from which information can be sorted, assembled, edited, compared and analysed at will.

Data extracted by I.B.T. machines can be processed automatically, used for calculations and summarised. Accountancy statements of all kinds can be produced in their final form from the original basic details contained in the punched cards.

DESIGN ADAPTABLE

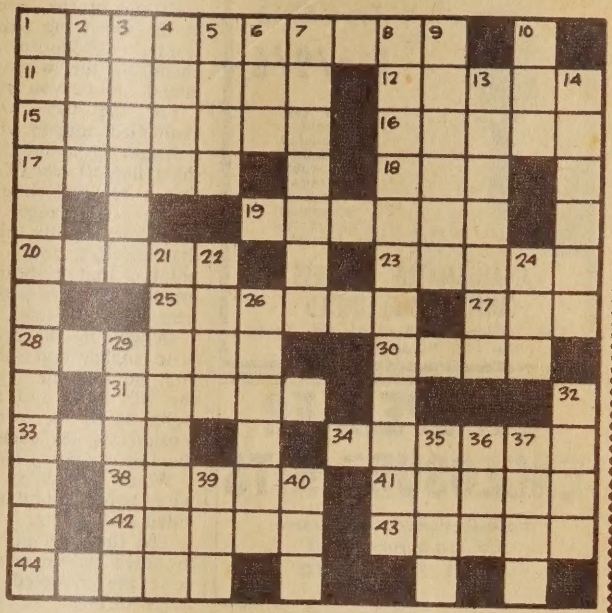
A great deal of information can be accommodated on a punched card. The design is infinitely variable. The design can be used for labour costing and this will differ considerably from one used for stock control, invoicing, or monthly statements.

Cards can be printed in the form of cheques with detachable stubs. The body of the card would contain all information regarding the customer's account.

The machine extracts from the cards the information and presents it in printed words and figures in the required form. These machines may be compared with an assembly shop of a factory for this is that part of the installation from which finished products are delivered, invoices, payrolls, costs, ledger sheets, debit and notes and the innumerable kinds of statistical information and figure analysis.

How the machines can perform the various functions will be told in the next month's article.

THE R., TV & H. CROSSWORD No. 70



DOWN

1. Coil intended to facilitate adjustment.
2. The perceive aurally.
3. Making a mistake.
4. Cereal.
5. Girls' name (pl.)
6. Not well.
7. Bony in character.
8. Principle used for TV sound.
9. Edible grain.
10. To or for each.
13. Hauling.
14. Lusty.
21. Used in power transformers (2 words).
22. Melody.
24. Writer.
26. Story told in episodes. Separated.
29. Skin.
32. Part of verb to be.
35. Way out.
36. Tear.
37. Apple.
39. Plump.
40. Soust, south - east (Abbrev.)

ACROSS

1. Describing the emission of electrons from hot bodies.
11. Antennae.
12. Unit of attenuation.
15. Packages.
16. Cornish town.
17. Levers.
18. Snake - like fish.
19. Enclosure for cattle.
20. Number 1-9.
23. For making temporary connections.
25. Nation.
27. Expressing denial.
28. To chant.
30. Extreme anger.
31. Inactive.
33. Gramophone record.
34. Type of oscillator.
38. Item of furniture. (pl.)
41. To banish from one's native country.
42. Mountains.
43. To reach maturity.
44. Extend welcome.

Solution and further crossword next month

CORRECTION: 1958 TV CIRCUIT

READERS' attention is drawn to an error which appeared in the circuit for the May, 1958, TV receiver. This concerns the cathode bias resistor for the last I.F. stage and which is shown at 1,000 ohms. This should be 180 ohms.

The error was due to the use of a new commercial I.F. strip for this receiver and which, due to modifications, was accompanied by a new circuit issued by the makers. Unfortunately, early copies of this contained the error (even though the unit itself was wired correctly) and the mistake slipped through into our own circuit.

It is likely that the higher value may aggravate any tendency to pulse clipping under strong signal conditions, possibly giving rise to poor synch as exemplified by picture pulling on high contrast images, etc.

Readers who built their own IF strip to this design would be well advised to check this point and correct it if necessary. However, commercial units should not require attention.

Last month's solution

B	A	N	D	S	P	R	E	A	D			B
A		O	A	T		O	A	R		C	A	R
N	O	N	R	E	A	C	T	I	V	E		O
K		I	N	N		K	E		R		A	
E	O	N	S		P	A	S	S	B	A	N	D
D		D		L	I	N	T			M		T
W		U		E	N	D	E	D		I		U
I	T	C	H	Y		R	E		S	C	A	N
N		T		D	O	O	R		E			I
D	R	I	V	E		L		T	R	A	I	N
I		V	E	N	A	L			I		N	G
N	E	E	R		R			H	E	A	T	
G			Y	A	C	H	T		S		O	

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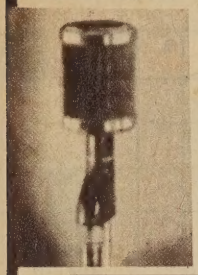
AWA RONETTE

MICROPHONES & ACCESSORIES



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FILTER STOPS "PLOPS"

(Continued from Page 79)

matrix board rivet about 7/16-inch from each end of the former. You will need to do something similar with whatever former you choose, since the means of anchoring the wire needs to be determined before you start winding.

For the coils we suggest 24SWG enamelled copper wire, close wound to a length of about 2 7/8 inches. Something like 50 feet of wire is required, so that a 2oz reel should be plenty.

The wire gauge is not critical and something slightly thicker or thinner than that specified could be used. The main point is that it should not introduce so much voltage drop that the coil tends to heat up under load.

In winding the coils, the best method is to anchor and solder the wire at one end, holding the former and wire with the left hand and rotating it with the right. Keep the wire under reasonable tension and lay each turn neatly against the last, avoiding slackness or kinks.

When complete, cut and clean the wire, twist around the lug already provided and solder.

The three-pin power socket should be mounted on top of the box before the coils are mounted. Drill a pattern of holes through the box to match those in the base so that leads can be pushed straight up into the base from inside and locked in place with the screws provided.

We used a scrap of plastic flex for the internal connections, mainly because the bulk of the wire, when twisted and doubled over is sufficient to lock firmly in place. Thin hook-up wire may not be gripped firmly enough by the locking screw, tending to pull out again or make a poor connection.

The internal leads need only be lo enough to run from the base to the c terminations.

At this stage, a 5/16 inch hole shou be drilled at one end of the box receive the incoming mains lead.

Next step is to mount the coils. Th must be held firmly, there must be danger of a short to the active wir and space must be left for the capa tors.

Our method was to make up fo ¾ inch inside diameter clamps from gauge brass, one to encircle each of coil ends. The ends were turned o wards and drilled with a 1/8 inch cle ance hole. Finally, they were locked position on long bolts passing throu the top of the case and with 3/8 i spacers between the case and the und side of the clamps.

If long enough, the same bolts secure the cover of the filter in place.

Three 600-volt capacitors are requi for bypassing. They should be physica small and preferably new capacitors, minimise risk of breakdown in servi resulting in a blown fuse. Their positi in the filter is obvious from the pho graph.

Twist the incoming mains lead wi around the adjacent screw, as sho before soldering them in position relieve the strain of any direct pull.

All earths joint at a common po near the centre of the box and bene the base. The clamps can also be retu ed to the earth point, if desired.

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